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ABSTRACT

This project included three separate studies undertaken to determine the effectiveness of television instruction as a method of effectively delivering information about solar energy systems to present and future workers in related industries, and as a method of delivery for adult continuing education instruction. All three studies used a series of five half-hour videotapes. A survey of the general public in the Las Cruces area was conducted to determine the number and occupational status of people watching the series on a local public broadcasting station. Surveys of random samples then assessed the prior level of knowledge on solar energy of residents from differing socioeconomic strata and any increase in knowledge after viewing the series. The worker study included apprentices, journeymen sheet metal workers, and materials handlers. These workers were given a pretest, shown the television series, and given a posttest. The relative effectiveness of television and regular instruction were compared in solar energy related vocational classes at two postsecondary institutions, and student attitudes concerning television instruction were assessed. Findings were generally favorable in all three studies, and television is recommended as a means of enabling adults of varying educational and age levels to participate in educational activities. Data, survey questionnaires, and references are included. (MER)

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EVALUATION OF TELEVISION AS A METHOD OF DISSEMINATING SOLAR ENERGY INFORMATION

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EVALUATION OF TELEVISION AS A METHOD OF DISSEMINATING SOLAR ENERGY INFORMATION

Introduction

With the increasing problems associated with the scarcity and rising costs of conventicnal energy sources, interest has increasingly been directed toward the development of alternative energy sources throughout the United States. Of these alternative sources, solar energy for heating homes, pools, and domestic hot water is the most immediately feasible. In a study of manpower training needs for alternative energy sources conducted in New Mexico and Arizona, it was projected that within the next five to ten years approximately 450 persons would be employed by the solar energy industry in New Mexico (Edington, Keaton & Neberay, 1978). Furthermore, employees in the construction industries and representatives of building trades have expressed a strong desire to train workers who would be involved in constructing solar homes as well as in installing and maintaining solar devices in homes. The desired area of training was in fundamental principles pertaining to solar energy systems. In response to this training need, a series of seven instructional units were prepared (Keaton & Edington, 1978).

Before the present study was conducted, a problem existed in effectively disseminating the needed information to persons in the building trades in New Mexico. A number of inquiries about the solar energy units (Keaton & Edington, 1978) have been received from educational planners in response to requests from building contractors and

union training coordinators. There has been a strong desire for a basic course in solar energy.

The target groups for this course are workers in, and persons being trained to enter, solar energy related industries in New Mexico. These individuals are dispersed throughout the state. Trained instructors who could provide the needed courses are not available state-wide. Therefore, a course on solar energy systems was needed which would facilitate delivery in all areas of the state to a population which, to any great extent, did not participate in continuing education.

Research indicates that at present the most frequent users of continuing education are persons with two or more years of college education and with high incomes (Boaz, 1978). Boaz (1978) and Brochart (1977) state that significant barriers to participation are time, distance from activity, and cost. Thus, the method of delivery of educational activities is of utmost importance and presents a real problem if available materials are to reach targeted learners.

One method of delivery which has been used successfully in some countries is television instruction. Televised courses in adult education have been used extensively and successfully in England, but according to Gross (1976), the necessary capital investment in research, planning, and production has never been forthcoming in the United States. In reporting the success of the University of Mid-America's programs, McBride (1976) indicated that additional research on effectiveness of special courses delivered via television is needed.

It would appear that a solar energy program packaged for public television could respond to continuing education needs of the general

public. A televised program could be viewed by workers in solar energy-related industries throughout New Mexico. Such a program could be viewed in a classroom or at home. Televised courses could be the answer to involving adults from varying socioeconomic groups who may not have been previously involved in continuing education.

Purpose

By preparing segments on solar energy systems to be televised over public television in New Mexico and for videotapes, the desired information about solar energy systems could be made available to a wide audience. But, before extensive educational programs for television are developed, it is desirable to determine the effectiveness of television as a method of presenting continuing education instruction for adults.

The purpose of the project was to develop television materials for continuing education instruction. These segments were prepared for use on public television as well as for videotape instruction.

The effectiveness of television instruction on solar energy was to be assessed as it relates to public television as well as classroom use.

Objectives

The major goals of this project were to assess television as a method of effectively delivering information about solar energy systems to present and future workers in solar energy-related industries and to assess its effectiveness as a method of delivery for adult continuing education instruction. The product, audiovisual and other educational materials, will be available for continued use in adult continuing

education courses. Specific objectives are to :

1. Develop television units as a method of disseminating educational materials on solar energy to the general public.

2. Develop television units for teaching workers in the construction industry about solar energy systems as applied to small buildings and homes.

3. Develop television units for teaching adult learners in communities throughout New Mexico about solar energy systems as applied to small buildings and homes.

4. Develop television units about solar energy systems which can be used for teaching adult learners in vocational classes.

5. Assess effectiveness of television instruction as a method of delivery of educational information to the general public.

6. Assess effectiveness of television instruction as a method of delivery of educational information to workers in solar energy-related industries.

7. Assess effectiveness of television instruction as a method of delivery of educational information to students in a vocational education class.

Accomplishment of each of these objectives is described in the remaining sections of the report. Development of the television series is described in the first section of the report. The next section describes the testing of the television units with the general public. In the third section, testing done with the solar energy related workers in a union is described. Testing done with vocational classes in solar energy related subjects is described in the next section of the report. Findings of all sections are summarized in the section on findings. The final section of the report includes recommendations for use of project results.

SECTION I

DEVELOPMENT OF EDUCATIONAL MATERIALS

DEVELOPMENT OF INSTRUCTIONAL MATERIALS

Printed Materials

The instructional materials used in the study were developed over a three-year period from 1978 to 1980. The development process is described below. The population of interest and the samples from that population are also described in this chapter. Various measurement and survey instruments were developed for use in the study. The instruments and the procedures for use of the instructional materials and data collection are outlined. Finally, the methods of data analysis used are included in this chapter.

The printed modules. In 1977-78, it was determined through a survey of manpower training needs in alternative energy areas that there was a training need in the solar energy industry (Edington, Keaton & Neberay, 1978). Employers in the construction industry and in the heating, air conditioning, and ventilation industry indicated that salesmen, installers, servicemen, and construction workers could benefit from a course on general principles of solar energy systems. At the time, there were very few instructional materials available which were suitable for the learners it was believed could benefit most from such a course. In response to this perceived need, a series of seven instructional units were prepared on the subject.

As a preliminary to a literature search, project staff met with representatives of the New Mexico Energy Institute and the Arizona Solar Energy Research Commission. Also, a consulting engineer who had worked with organizations in northern New Mexico to plan training

programs on solar energy systems provided materials and suggestions. A literature search was then conducted for source materials to be used in preparing the units.

The instructional units were designed for post high school technical education and adult education programs. The format for the units was recommended by the New Mexico State Vocational Education Division. A representative from that agency served as a consultant during the preparation of the seven units. A preliminary draft of each unit was reviewed by a representative of the New Mexico Energy Institute for technical accuracy. Finally, the modules were field tested by the Wisconsin Vocational Studies Center before publication.

Test questions had been prepared for each instructional module. Since the information in the first three instructional units corresponded to the information in the first audiovisual segment, questions were selected at random from the first three modules. These questions were reworded for use in the study.

After the test was administered to 10 volunteers, further modifications of the test items were made. The test was then used for pretest and posttest purposes.

The audiovisual segments. In initial meetings with the representatives of the National Training Fund, the training coordinator of the sheet metal workers apprenticeship training program, and representatives from the Department of Educational Management and Development, the New Mexico Solar Energy Institute (NMSEI), and the public television station at New Mexico State University, KRWG-TV, it was planned that the 30-minute television or audiovisual segments

would be based on the instructional units. The first two meetings involving representatives from the organizations listed above produced a list of objectives and outlines for the series. A third meeting was held after a list of materials required had been compiled. At this meeting, methods of presenting important concepts were discussed.

However, as the outlines developed, it was decided to include more information on domestic hot water, passive systems, and retrofit systems than appears in the printed instructional units. During the two years since the instructional units had been prepared, a great variety of mechanisms and techniques for utilizing solar energy have been developed. The opinion of the technical experts from NMSEI was that these new applications should be included to indicate the number of ways in which solar energy principles can be applied. Basic principles of solar energy were to be introduced and then a variety of applications indicated. The basic principles parallel those in the printed units. However, since the audiovisual medium is at its best in presenting materials visually, there was a move to take advantage of the versatility of the medium to demonstrate a number of applications. The series titles were as follows: I: Basic Principles of Solar Energy Systems; II: Passive Solar Energy Systems; III: Hot Air Active Systems; IV: Liquid Active Systems; V: Retrofit Passive Systems.

A number of charts were selected and developed for the series. The graphics were developed to illustrate the major components of a specific system or subsystem. The flow of a fluid or of heat movement could be traced through the system. Thus the narrator could first

explain the components and then talk the viewers through the system using a graphic display. This aspect of the use of the audiovisual medium was throught to be an important advantage of the medium over print (see Solomon, 1974). By pointing out the components; the direction of movement of heat through natural conduction, convection, or radiation or the movement of the heat transfer fluid in an active system; and the sequencing of component functions in the system while explaining how the system works, the narrator can make optimal use of the audiovisual medium. Provided an instructor has extensive graphic materials available, the same can be accomplished in face-to-face instruction but is much more difficult to effect in printed materials, where the verbal explanation is necessarily separated from the graphic presentation.

After explaining the system using a graph, the audiovisual presentation makes it possible to show an actual system accompanied by further explanation. This further dimension of the audiovisual medium--the ability to show the actual trombe wall or rock storage bed--provides information not available in a classroom situation, although photographs can be used and explained in the classroom, or in a printed manual with accompanying written explanations.

As the graphics were planned and developed, the original outlines were modified. Finally, outline scripts were prepared which gained the approval of the technical consultants from NMSEI. At this point, it was decided to use narrators from NMSEI. It was suggested by the representative of KRWG that using narrators with technical training would provide a technical credibility which might be lacking if a

nontechnical person narrated the segments.

Throughout the planning sessions, two audiences were targeted. As with the printed instructional units, the audiovisual segments were intended for use by learners in postsecondary vocational and technical programs and in adult education programs. It was believed, also, that the materials would be of interest to a general audience. It was decided that the language and technical information should be suitable for persons with an eighth-grade education. While it was expected that the audience would be composed mainly of persons with at least a high school education, that education might have been acquired some time ago. Employees or students in solar-related industries might be technically more sophisticated than a general audience but still not be highly proficient with language. On the other hand, while a general audience might have a greater language proficiency than the workers and vocational students, their technical training might be minimal. It was believed the compromise reached in order to serve both audiences would not be detrimental. The nature of the audiovisual medium seems to require simpler language and a less complex or information-loaded message (Lumsdaine, 1963).

At each taping session, a reviewer from NMSEI checked the accuracy of the narrator's on-camera monologue. A member of the project staff was also present during all planning and taping sessions. After the tapes were edited, each segment was again reviewed by a member of NMSEI.

During the review sessions, the project staff took notes from which test items were prepared. Again the test was administered to

volunteers, and modifications were made if an item seemed ambiguous or misleading. The test was used for pretest and posttest purposes.

A brochure was prepared to describe the units to individuals who might wish to make use of the videotapes in the future. The complete content from the brochure is included in Appendix A.

"Understanding Solar Energy Systems" is a series of videotapes developed by New Mexico State University's Department of Educational Management and Development and the New Mexico Solar Energy Institute. It was produced by KRWG-TV on the NMSU campus and was funded by a grant from the New Mexico Board of Educational Finance and the National Training Fund for the Sheet Metal and Air Conditioning Industry.

The five one-half hour videotapes were developed for use as an educational tool for the building trades but can be used for general public education on solar energy principles. The tapes present the concepts clearly and concisely and have the advantage of on-site illustrations for many of the designs discussed.

These tapes are available at cost from:

Production Manager
KRWG-TV
Box 3J
New Mexico State University
Las Cruces, N.M. 88003
(505) 646-4403

A copy of the tapes can also be viewed at the New Mexico Solar Energy Institute in Las Cruces, New Mexico, on the New Mexico State University campus.

SECTION II

TESTING OF TELEVISION UNITS WITH THE GENERAL PUBLIC

EFFECTIVENESS OF TELEVISION INSTRUCTION AS A DELIVERY METHOD FOR THE GENERAL PUBLIC

Introduction

Within the state of New Mexico and across the nation, interest in lifelong learning and adult, continuing education is growing. The impetus for such programs is coming from a number of directions. National and international policy makers see in adult education possible means of effecting desired social change. Post-secondary institutions are responding to a growing demand for education from a new group of adult learners at a time when most institutions were preparing to face problems associated with shrinking traditional enrollments. Outreach programs are taking education to adults, who for various reasons, cannot come to the campus. The demand for education has come from adults some of whom are searching for activities stemming from an increase in leisure time or a desire for understanding of themselves or others. Another force which has served to increase interest and participation in adult continuing education has been the need for additional learning because of our knowledge explosion. The need to update skills and to keep abreast of advances in technology is bringing increasing numbers of working adults back to the classroom.

Studies of who participates in adult and continuing education in the United States indicated that participants are in their early thirties, white, more highly educated, a white collar or professional worker, and from a higher income household [Organization for Economic Co-operation and Development (OECD), Vol. IV, 1977]. Barriers to adult education center around time, cost and distance (Marineau, 1975; Nurnberger, 1974;

Robinson, 1976).

Education is traditionally considered tp be a means of acquiring a better job or higher income. Adult education is viewed by policy makers as a means of achieving greater equality of opportunity (OECD, Vol. I, 1977). However, if adult education is to be effective, the barriers to participation must be removed so that a broader spectrum of the adult population actually participates in adult education programs.

A number of steps can be taken to encourage increased participation among the adult population. A first step is, of course, greater access. Greater access leads us to a consideration of the media of instruction: print, audiovisual (television or film), and so on. In considering the use of the media of instruction for facilitating the delivers of adult education, several questions immediately come to mind. A most important question centers around people's willingness to use a particular medium of instruction. The use of a particular medium of instruction may facilitate or deter a person's willingness to participate in a class. For example, if in the past a person was unhappy or unsuccessful in an academic situation, a class structured around the lecture may deter participation because the individual will be unwilling to voluntarily undergo an unpleasant experience (Cronbach & Snow, 1977; Travers, 1967).

Televised instruction broadcast into the user's home provides wide access and minimizes the other barriers to instruction which have been suggested, namely, time, cost, distance of travel. But even when the program is available in the home, people may not know that a program is being broadcast. Also the program will be one option among many.

Habit and attitudes will contribute to a propensity to participate in a continuing education program. Easy access, a program on television, will make the probability of participation even greater. The medium of instruction may then be of little consequence; the major consideration may be the subject or course content.

Adult education is a possible means of updating the knowledge and awareness of the general public in New Mexico with regard to solar energy. An investment in a solar heating system for one's house is not to be taken lightly. Before people make such an investment they must understand what the system is and what performance can be expected of the particular system they purchase. Only if there is an increased awareness and understanding of solar energy uses will people be willing to invest in this alternative energy source. Thus adult education can be an instrument for desired social change.

If we accept the assumption that participation in continuing adult education by all segments of the population is a desirable goal, then strategies for obtaining greater participation rates must be examined. Studies suggest that, to increase participation, time, cost and length of travel must be minimized. The vehicle for delivery of instructional materials is a key to increased participation by persons who do not normally make use of available adult continuing education opportunities.

Televised instruction appears to overcome many of the barriers to participation named above. However, although the use of television as a medium of instruction has been studied extensively, little of this research has attempted to deal with the use of television as a vehicle of instruction aimed at adult learners (Campeau, 1974; Schramm, 1972).

Thus a study to determine if television, as a media of instruction, is likely to increase participation and knowledge, and if sufficient learning occurs to merit the cost of producing the learning materials seemed worthwhile.

To examine the problem, a two-part study seemed desirable. First, it is of interest to determine how many people among the general public will watch a televised educational program and to obtain some demographic information about the viewers. A program on solar energy utilization for heating buildings should have broad general appeal with some possible payoffs, in terms of information which would increase savings on utility bills, information which would enable consumers to make informed decisions, and, for some, information related to their jobs. A fairly intensive publicity campaign preceding the broadcast should heighten awareness of the program's availability. Therefore, a survey to determine the number of people watching and their occupational status level should provide useful information for educational planners. To obtain this information, a random sample of households in Las Cruces, New Mexico, was surveyed to determine how many people actually watched the program.

Second, it is of interest to determine if a videotaped instructional program on the principles and practices of solar energy substantially enhances knowledge for residents from all income areas. Whether televised courses could be the answer to informing adults from varying socio-economic groups who have not been previously involved in continuing education can be determined. To obtain this information, a study will be conducted to test the effectiveness of a videotaped instructional

program on increasing knowledge of solar energy. A random sample of residents from all socio-economic groups will be surveyed to assess their knowledge level. Another random sample of residents from the same socio-economic groups will be shown the televised program. Differences between these two groups will be assessed to determine if the televised instructional program is an effective means of increasing the knowledge and awareness of the general public with regard to solar energy.

Methods

The populations, sampling procedures, and experimental procedures used to survey the general public and test the effectiveness of the television instructional program are described in two parts. The first part is the description of the procedures used in the survey and the second part is the description for the effectiveness of a televised instructional program.

Study 1. Survey of the General Public

Population and Sample

The population for the survey of the general public consisted of adults over 18. For the survey of adults viewing a program televised over a public broadcasting station, the population was limited to adults living in the area of Las Cruces, New Mexico. This limitation was necessary for very practical purposes. The program of interest was broadcast over KRWG-TV, which is located in Las Cruces. According to the City of Las Cruces Planning Department, a special census conducted by the city in April 1979 counted a population of 50,729 with 16,664 households in the Las Cruces urbanized area (City of Las Cruces Planning Department, 1980). This includes area contiguous

to the city boundaries. Las Cruces has a university community, a technical community associated with nearby military installations and the university, and a farming community. About 50 percent of the population is Anglo American; the other 50 percent is predominantly Mexican American, with blacks and Orientals also represented in the community.

The sample contacted by telephone was obtained by a computer-generated, randomized search procedure which produced a listing by page, column, and line number of the "Las Cruces Only" telephone directory. These listings were translated into telephone numbers. While using telephone numbers may introduce bias into the sample, it seems reasonable to assume that the probability is high that households without telephones probably are also without television sets. The telephone company has 23,195 household accounts for Las Cruces only. This includes smaller surrounding communities and farms. The sample was drawn from a computer listing representing the larger number of households. The viewing area of KRWG-TV extends beyond this larger area.

The households were contacted either during or immediately following the program. The program began at 7:00 p.m. A listing of 300 telephone numbers had been prepared, with a number listed on each copy of the interview questionnaire (see Appendix B).

Members of a New Mexico State University student organization performed the actual calling. Each person made two practice calls using the interview schedule. They were instructed to ask for a member of the household over the age of eighteen. After reaching a

suitable respondent, the callers explained that they were doing a survey for a class and needed the respondent's help. If the resident replied negatively, tne caller thanked the resident and discontinued the interview. If the resident replied favorably, the 10 items on the interview schedule were completed, the respondent was thanked, and the interview concluded. If on one answered the telephone or if the number was busy, the number was dialed a second time. The 300 calls resulted in 156 usable responses, as indicated in Table 1.

TABLE 1

TELEPHONE SURVEY OF GENERAL PUBLIC:

Breakdown of Usable and Unusable Numbers

Outcome of Call	Number
Responded to questions	156
No television set	2*
Did not speak English	3**
Refused to cooperate	28
Disconnects	32
No answer	77
Number changed to unlisted	2
Total	300

*Head of one household without a television set was a professor at New Mexico State University.

**One caller spoke Spanish and administered the instrument in Spanish when required. Therefore, some responses are from households with no English speakers.

Procedures

Preceding the broadcast of the first audiovisual segment, a moderate publicity campaign was undertaken. A news release prepared by Information Services, NMSU, was sent to all local papers, radio, and television stations. Handbills were posted in several restaurants and hardware stores and at the city library. Also handbills were placed on counters at a number of establishments.

The survey to determine the number of viewers of an educational program on solar energy was conducted during and immediately following the broadcast of the first unit: Basic Principles of Solar Energy Systems. The interview schedule (Appendix B) consisted of 10 questions. Respondents were asked if anyone in the house was watching television, if anyone was watching the program on solar energy, and if the respondent knew the program was being shown. All respondents were asked their age and the occupation and education of the household head. Respondents who were watching the program were also asked how many people in the home were watching and their age and sex. The caller was asked to note the sex of the respondent. It was decided that it would be inappropriate to ask any questions referring to ethnicity.

Study 2. Televised Instruction for the General Public

Population and Sample

The population used in this experiment were 97 male and female adults, over 18 years of age, who resided in a city in the southwestern part of the United States. Each person received either $5.00 or $10.00 for participating. Which experimental condition the subject was in determined the exact amount of stipend.

A 3 by 2 factorial treatment design was used. Three levels of economic status, low, middle, and high, comprised the first factor and the condition of a TV program and no TV program comprised the 2 levels of the second factor.

The sampling procedure occured in two phases. In the first phase, 30 names were randomly selected from each of the three different economic areas in the city. The economic areas were identified by several marketing experts who were employed at the local university. The names of the residents were selected from a city directory which listed residences by street and area of the city.

Procedures

The two conditions used were; no TV and TV. In the first condition, no TV, two interviewers visited each of the 90 randomly chosen households and asked for someone who was over 18 years of age. When an appropriate respondent appeared, the interviewers explained that they were students at the local university and were assisting with a doctoral dissertation. A brief explanation of the project and what was desired of the respondent was given. The resident was asked to answer a series of test questions regarding the principles and practices of solar energy and was assured that he/she was not expected to know all the answers (see Appendix C).

The test was given to those residents who agreed to participate and the interviewers answered any general questions the resident had. Upon completion of the test, the resident was given $5.00, a receipt, and was thanked for his/her assistance.

In the second condition, TV, a letter of introduction, which explained the project and asked for cooperation, was mailed to each of the 45 residents chosen in the second phase of the sampling. It was also mentioned in the letter that the resident would be paid $10.00 for participating and that he/she could view at his/her convenience on one of three different dates, a videotaped film on the principles and practices of solar energy (see Appendix A). A confirmation form was enclosed along with a self-addressed, stamped envelope so that the resident could reply. Several days later, each of the 45 people were contacted by telephone and the project was explained to them again. At this time a verbal confirmation or rejection was obtained. Also those residents who agreed to participate made an appointment to view the film.

The film was shown on three different days so that most residents would have the opportunity to view the program. After viewing the program the participants took a paper and pencil test which measured knowledge of the principles and practices of solar energy. This was the same instrument which was administered to participants in the NO TV condition.

After the first two testing dates had passes, it was discovered that there would be an insufficient number of subjects for the experiment. Other people in each of the three economic areas were contacted and asked to participate. However, during the third viewing and testing period, it was discovered that in two of the three economic areas, there were more residents who viewed the film than required.

Findings

The results of the data analysis are presented in this section. The analyses are divided into two parts: (1) the results of the survey of the general public are discussed with regard to certain demographic variables and (2) the results of the television instructional program are presented.

Study 1. Survey of the General Public

Number of viewers. The telephone survey used 300 numbers. Of the 300 numbers dialed in the telephone survey, 60 numbers were discarded. The resulting sample of 240 numbers resulted in 156 usable responses. The program on solar energy was seen in 13 households and viewed by 20 people, 18 adults and 2 children.

For estimating the total viewing public, the percentage of households in the area viewing the program was calculated by dividing the number of households viewing the program by the total number of usable numbers. This resulted in 5.4 percent of the sample of households in the Las Cruces only area.

The telephone company reported 23,195 household accounts for Las Cruces in February 1980. Using this figure, the total number of households viewing the program, is estimated at 1,253. Since there were slightly more than 1.5 viewers per household, it is expected that approximately 1,900 persons were watching the program, most of whom were adults.

The program was shown at 7:00 on Friday night. Of the 240 usable telephone numbers, there were 77 no answers, and 28 persons answered but refused to cooperate. On a weekday evening, better results could

probably be obtained, with more people at home and uninvolved in an activity which would interfere with viewing the program.

Television sets were in use in 110 of the 156 households contacted. In addition to the 13 households in which someone was viewing the program, 12 households were aware that the program was available. Thus, about one-half of the people who know that the program was being shown and who were watching television at the time of the interview were watching the program on solar energy. These figures indicate that the program had appeal for a general audience but overall awareness was not high. It would appear that aggressive marketing of television programs ano solar energy could greatly increase the participation rate.

The following paragraphs and tables will analyze certain demographic characteristics of the respondents. Where possible, comparisons will be made with characteristics abtained from national studies of participation rates. It should be noted that the number of responses in each category differs slightly. On several occasions the respondent wished to conclude the interview before all questions had been answered, or refused to give information in response to a particular question.

Age of respondents viewing the program. Table 2 gives the age of the respondents. A chi square was computed comparing the age of respondents who watched the program on solar energy with respondents who did not view the program. The age of respondents who watched departs significantly from non-viewers.

National participation by three age groups was reported for 1975 as shown in Table 3.

TABLE 2

Age of Respondents

Watched Program on Solar Energy	18-24	25-34	35-54	55-64	>65
Yes	1	2	4	2	4
No	39	31	38	14	15

$X^2 = 12.583$

TABLE 3

National Participation in Adult Education by Age

	Number in Population 17 years and over (1975) (in thousands)		
Age	Total Population	Participants in Adult Education	%
17-34	60,038	9,604	15.9
35-54	45,871	5,829	12.7
55 and over	40,693	1,627	3.9

Note. Boaz, 1978, P. 4.

In Table 4, the ages of viewers over 18 in the Las Cruces Sample are shown with projections from the national data(Table 3). The calcualted chi square is significant at less than the 1 percent level. As can be determined by an examination of Table 4, the program on solar

TABLE 4

Age of Viewing Audience

Age	No. of Viewers	Projected from National Data[a]
18-34	5	8.8
35-54	4	7.0
55 and over	9	2.1

$X^2=25.6$

[a]Based on percentages in Table 3.

energy appealed to an older audience than would normally be expected.

Sex of respondents viewing the program. Sex of the respondent in the survey is obviously of less importance than sex of the viewer. Sex of those responding to the interview schedule is shown in Table 5.

TABLE 5

Sex of Respondent

Watched Program on Solar Energy	Male	Female
Yes	10	3
No	63	80

A breakdown of participation by sex from the national data is shown in Table 6.

TABLE 6

National Participation in Adult Education by Sex

	Number in Population 17 years and over (1975) (in thousands)		
	Total	Participants in Adult Education	%
Male	68,810	8,027	11.7
Female	77,792	9,032	11.6

Note. Boaz, 1978, p. 6.

In the Las Cruces sample, differences by sex are no greater than would occur by chance (see Table 7); again, the projections are obtained from the information on national participation rates (see Table 6).

TABLE 7

Sex of Viewing Audience

Sex	No. of Viewers	Projected from National Data[a]
Male	11	9
Female	7	9

[a]Derived from percentsges in Table 6.

The sample of viewers is in line with national data with regard to this variable.

Education of head of household. The respondents were asked the level of education of the head of the household. The responses, both for viewers and nonviewers, are shown in Table 8.

TABLE 8

Education of Head of Household

Watched Program on Solar Energy	No School	Grade School	Some High School	High School Graduate
Yes	0	0	0	2
No	2	3	15	44

Watched Program on Solar Energy	2-year Certification Program	Some College	College Graduate	Graduate School
Yes	2	2	3	4
No	2	16	27	31

As can be seen from Table 8, all of the household heads were either high school graduates or had been enrolled in a post-secondary educational program. Two of the 13 respondents(15.4 percent) were high school graduates, while 53.8 percent had at least a college degree. Of the total number of heads of households, 43.1 percent had a high school diploma or less education, while 5619 percent had acquired schooling at post-secondary levels and 22.9 had graduate level training or graduate degrees.

The 1970 census indicated that the median school years completed by persons 25 years and older in New Mexico was 12.1 (NACAE, 1974, p. 132). In the last ten years. the median education level has probably risen for new Mexico, but still the survey sample will probably prove to be over-represented at the higher education levels. However, it is obvious that the program on solar energy drew its audience from persons with high educational attainment. Whether this imbalance is owing to the subject matter or to the fact that the program was broadcast over a ultra high frequency (UHF) channel cannot be determined.

National participation by level of education is shown in Table 9. For the purpose of this analysis, four years of high school or college will be used synonymously with high school or college graduate. The sample of participants and expected numbers, from the national data, are shown in Table 10.

TABLE 9

National Participation in Adult Education by Level of Education

Highest Level of Education Completed	Number in Population 17 years and older (1975) (in thousands) Total	Participants in Adult Education	%
Less than 4 years of high school	53,388	1,756	3.3
Four years of high school	53,755	6,396	11.9
One to three years of college	21,002	3, 687	17.6
Four or more years of college	18,457	5,220	28.3

Note. Boaz, 1978, p. 6

TABLE 10

Observed and Expected Education Level

Highest Level of Education Completed	Las Cruces Sample	Expected[a]
Less than 4 years of high school	0	.7
Four years of high school	2	2.5
One to three years of college	4	3.7
Four or more years of college	7	6.0

[a]Based on percentage from Table 9.

A chi square for goodness of fit is inappropriate because of the small sample size; however, the observed and expected sizes are very close. It appears that the program attracted persons with a high education level, as do continuing education programs generally.

Income of head of household. As was explained previously, it was thought that asking a direct question about income would lead to noncooperation. Instead, an estimate of income was made derived from information about occupational prestige and socioeconomic status. Three levels of income were determined by this method. Occupations and their prestige classification are indicated for the respondents in the Las Cruces sample in Table 11.

TABLE 11

Occupation and Occupational Level

Occupational Prestige Scale	Occupation	Occupational Level	Number	
			Viewers	Nonviewers
High Professional	Doctor, Lawyer, University Professors, Engineers, etc.	High	4	13
Low Professional	Accountant, Counselor, Mathematician, Nurse, Teacher	Intermediate	2	13
Managerial, Official	Contractor, Self-employed, Procurement Officer	Intermediate	1	18
Skilled Worker	Technician, Carpenter, Electrician, Truck Driver, Plumber, Bricklayer	Intermediate	2	21
Clerical, Sales	Bookkeepers, Secretarial, etc.	Low	0	15
Operative (semi-skiller)	Bartender, Waitress, Cook, Pressman	Low	0	7
Laborer (Unskilled)		Low	0	3
Retired, Students, Unemployed, Disabled			4	44

Note. Groupings derived from Hall, 1975; Edington, Pettibone, & Heldt, 1975.

The national data for participation by annual family income is shown in Table 12.

TABLE 12

National Participation in Adult Education by Family Income

Adult Population (17 years and over) for 1975

Annual Family Income	Number in Population (in thousands)			
	Total Adults	Participants in Adult Education	%	
$5,000-$9,999	31,518	3,102	9.8	11.4
$10,000-$14,999	33,198	4,294	12.9	
$15,000-$24,999	34,118	5,408	15.9	
$25,000 and over	13,408	2,372	17.7	

Note. Boaz, 1978, p. 7.

By combining the first two groups in table 12, projections of the distributions of the participants by income can again be made, as shown in Table 13. Since the incomes of the four retired persons cannot be ascertained, they are not included in Table 13.

TABLE 13

Observed and Expected Participation by Income

Income	Las Cruces Sample	Expected[a]
Low Occupational Level	0	3.3
Intermediate Occupational Level	5	4.6
High Occupational Level	4	5.1

[a]Based on percentages in Table 12.

Again computing a chi square statistic is inappropriate because of the small sample size. However, the values in Table 13 suggest that any differences could be explained by chance variation, although there is a tendency towards participation by higher income level.

A comparison of the data for the heads of households who knew the program was being broadcast but did not watch is of interest (see Tables 14, 15, and 16). The sample size is too small to use a chi square analysis. However, very little difference can be seen in the groups for age or occupation. Those viewing appear to be the more highly educated (Table 15).

TABLE 14

Comparison by Age of Respondents Knowing
Program Was Being Shown

Viewed Solar Energy Program	16-34	35-54	55 and over
Yes	3	4	6
No	4	2	6

TABLE 15

Comparison by Level of Education of Household Heads
Knowing Program Was Being Shown

Viewed Solar Energy Program	High School Graduate	Some College	College Graduate or Graduate School
Yes	2	4	7
No	4	3	5

TABLE 16

Comparison by Occupational Prestige Level of Household Heads Knowing Program Was Being Shown

Viewed Solar Energy Program	High Professional	Low Professional	Managerial, Proprietary	Skilled (Technicians)	Retired
Yes	4	2	1	2	4
No	0	3	1	2	4

The sample size is too small for chi square goodness of fit tests to be calculated on the data in Tables 14, 15, and 16. However, any observed differences are so small that variations are probably attributable to chance.

Study 2. Televised Instruction for General Public

Because some of the residents who were contacted did not agree to participate or did not attend the scheduled viewing session, the number of subjects in each cell is not equal. In the NO TV condition data was obtained from the following: 15 of the 27 households in the high income area, 14 of the 20 households in the middle income area, and 12 of the 36 households in the low income area. In the TV condition, two of the residents from the low income area who were scheduled to view the film failed to keep their appointments. As this was on the third viewing date, it was not possible to reschedule them or obtain additional subjects. In both the middle and high income areas, there were more subjects who viewed the program than originally planned. As it was not possible to determine which subjects were contacted first and which were contacted later all of the people were allowed to participate.

Participant reactions to the TV program were varied. Many said the program was better than anticipated and that it was informative. Others indicated that although the program was well done, it was too technical for the general public. A few of the people expressed an interest in viewing additional programs.

To assess the effects of viewing the TV program an analysis of variance for an unbalanced factorial treatment design was conducted. This analysis was used because of the unequal number of participants in

each cell. As shown in Table 17, there was a significant main effect due to TV condition, a significant main effect due to income level, and a significant interaction between income level and TV condition. A plot of the interaction as shown in Figure 1 indicates that the effect of the TV viewing depends, in part, on income level. This interaction indicates that the effect of viewing or not viewing the TV program is different under different income levels. In order to examine these differences, several one way analyses of variance were conducted.

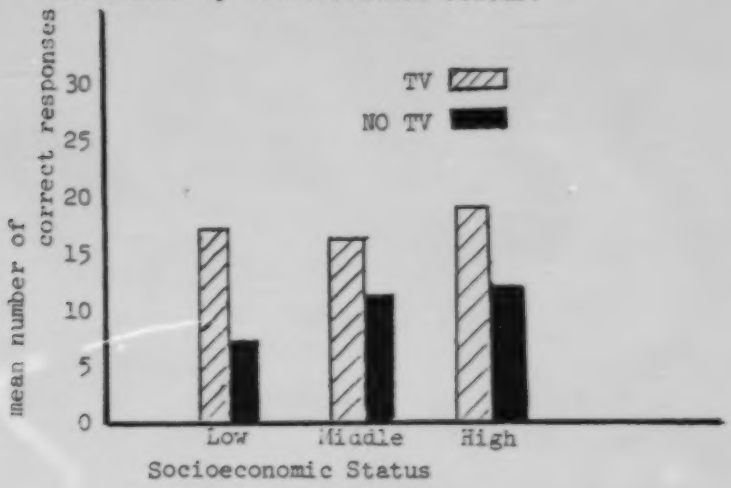
TABLE 17

ANALYSIS OF VARIANCE ON NUMBER OF CORRECT RESPONSES BY CONDITION AND SOCIOECONOMIC STATUS

Source	d.f	SS	MS	F
Total	96	2515.94		
Condition	1	991.24	991.24	68.51**
SES	2	115.15	57.58	3.98*
Cerd.X SES	2	92.83	46.42	3.21*
Error	91	1316.73	14.45	

* $p<.05$
** $p<.01$

Figure 1. Mean number of correct responses for the TV and NO TV conditions by socioeconomic status.



It was found that given the TV condition, there were no significant differences between income levels, $F(2,53)=1.23$, $p>.3015$. However, there were significant differences between income level in the NO TV condition, $F(2, 38)=7.65$, $p>.01$. Examination of Figure 1 suggested that these differences lie between the low income group and either the middle income group or the high income group or both. The differences between teh high and middle income groups in the NO TV condition appeared too small to be significant. As shown in Table 18, further analysis indicated that for all income groups, there were significant differences between the TV condition and the NO TV condition.

TABLE 18

SUMMARY OF THREE SEPARATE ANALYSES OF VARIANCE FOR TV CONDITION GIVEN INCOME LEVEL

Income Level	d.f.	F
Low	(1, 23)	48.29**
Middle	(1, 36)	10.20*
High	(1,32)	24.19**

*p<.01
** p<.001

Discussion of Results

The results showed that although the TV program group scored significantly higher than those without the TV program, there was a significant interaction of condition and income level. This indicated that the effect of the TV program was different depending on income level, however further analysis showed that the different effects occurred with the groups which did not view the TV program. The low income group was substantially less informed about solar energy than either the middle income or high income groups. A possible reason for this is that more people from middle and high income levels than from low income levels own their own homes and seek information relative to energy alternatives. The fact that those people in all income levels who viewed the TV program were significantly more knowledgeable concerning solar energy than those who did not view the program is very encouraging. It is also encouraging that there were no significant

differences due to income level for those who viewed the program. This indicates that the use of a televised instructional program is highly effective in increasing knowledge concerning the principles and practices of solar energy for people from all income levels. It is interesting to note that although those low income residents who did not view the televised program were less informed than those from higher income levels, those low income residents who did view the program were slightly (non-significantly) more knowledgeable than residents from the middle income area. These findings suggest that the use of a televised instructional program is beneficial to all residents regardless of income level but it is particularly beneficial to residents from low income areas.

There were a few problems encountered in conducting the study which may, in part, account for the results. One of these is that in both of the low income groups, many of the residents did not speak English. Several of those in the NO TV condition declined to participate because of the language problem, thus those that did participate were able to speak English. It was also found that becuase several of the residents from the low income area in the TV condition could not speak English, they could not benefit from the tape which was in English.

Two additional complications also occurred. It was discovered that several of the residents in the low income area did not have telephones and some did not have transportation. For several residents it was not possible to confirm a viewing date and because the residents were required to transport themselves to the viewing of the tape, it was impossible for others to keep their appointments. These complications, which occurred for the residents from the low income area, did not occur for

residents from either the middle or high income areas. These problems suggest that those people from the low income area who participated in the experiment were perhaps not representative of low income residents in the city. The residents that did participate spoke English, had some form of transportation, and had telephones. This was not the case for all low income residents in the city. It is not possible to determine from this study whether low income residents who speak Spanish, do not have telephones, or do not have some form of transportation would benefit from a televised instructional program on solar energy.

Summary

The telephone survey resulted in 156 usable responses, and 110 respondents reported that their television set was on during the program. The program was seen in 13 households with a viewing audience of 20 persons. Using this participation rate, it was estimated that approximately 1,900 persons saw the program in the survey area. A chi square, computed with respect to viewing and nonviewing respondents, revealed a significant difference with viewers being older than nonviewers (see Table 2). In the Las Cruces sample, the sex ratio of the viewers did not depart from chance expectations. The sample of viewers was also in line with national data with respect to this variable. The educational level of the heads of the viewing households was considerably above that of heads of nonviewer households and in line with expectations based upon national figures for participants in adult education programs (see Tables 8 and 10).

The results of the televised instructional program showed that television is an effective means of disseminating information concerning

solar energy to the general public. A significant interaction occurred between income level and TV program, however residents in all income levels who viewed the TV program were significantly more knowledgeable than those residents who did not view the program. Of those residents who did not view the televised program, the low income residents were less knowledgeable concerning solar energy than were residents from the middle or high income areas. Of those residents who did view the program, there were no significant differences in knowledge between income levels although the low income residents were slightly more knowledgeable than middle income residents.

Conclusions

The televised segments had appeal for a general audience, as was indicated by the results of the survey of the general public. Of those who know the program was being broadcast, over 50 percent actually viewed the program. This viewing rate suggests that Las Crucens are eager to learn about solar energy utilization.

Furthermore, older persons, including retired individuals as heads of households, were well represented in the viewing audience. Solar energy design and utilization represents a means of avoiding rising energy costs; thus, it seems reasonable to suppose that persons who are retired or who are considering retirement and anticipating living on fixed incomes are particularly interested in learning how to make use of solar enegry in planning a retierment home. For this group, the payoff can be of especial importance.

Whether or not the programs would have appeal to persons from lower socioeconomic or education levels is problematic. We can conjecture that

such persons are not familiar with the ultra high frequency channels and so did not watch the program. It is also possible that such persons might be convinced from previous information sources that the purchase cost of installing any devices for utilizing solar energy are beyond their means and thus they will make no further efforts, including watching a television series, to obtain information. Such an attitude, if it exists, cannot be changed overnight; however, it is possible that careful marketing can create an atmosphere in which more people will wish to obtain information. As more solar homes are built, more people will want to know what their housing dollar will buy in terms of solar energy. The availability of an audiovisual series which can be viewed either at home or at a convenient learning center can eventually lead to a social milieu in which wider acceptance and use of solar energy for home heating and cooling systems will be achieved.

Part of the solution resides in providing the information in a language which the residents can understand. Some of the problems encountered in the study of the television instructional program indicated that language might be an important barrier to participation for low income residents. As was mentioned previously, the research indicates that those who participate in adult and continuing education in the United States are, among other things, from a higher income bracket. The barriers to participation for these people include cost, time, and distance of travel. If information on solar energy is to be disseminated to low income residents, the additional barriers to participation of language and availability of transportation must be taken into account.

The results of the segment on television instruction showed that

all residents, regardless of income level, had a significant increase in knowledge after viewing a videotaped program on solar energy. Because there were no significant differences in this knowledge between income levels, it appears that a televised instructional program could be used to disseminate solar energy information to all residents in New Mexico. The effectiveness of the dissemination could be greatly enhanced if the barriers of language and availability of transportation are overcome.

Thus greater participation in adult education can be achieved by breaking barriers such as cost, time, and distance by broadcasting audiovisual training materials into the home. For the educational planner, the study provides assurance that learning gains will occur, i.e., the programs, chosen carefully for course content, will draw a sufficiently large audience with substantial learning occurring to be cost effective. It is extremely unlikely that 1,900 people would have left their homes to attend a class on solar energy. Yet, the survey suggests that an audience of this order of magnitude was interested in learning about solar energy when the information was available to them in their homes.

Recommendations

1. It is recommended that audiovisual materials be used for the dissemination of information about solar energy and comparable technical subjects. The moderately high interest in these kinds of programs detected by the survey indicates that such programs are marketable. Since there programs are both effective and marketable, cost-benefit considerations should lead educational planners to follow the recommendation.

2. In distributing the budget for televised instruction, more money should he committed to advertising the programs. Of 156 households that were contacted, only 23 respondents knew the program was being broacdast. Of those 23 households, the program was being watched in 13 homes.

3. To adequately disseminate information on solar energy to the general public in New Mexico, the television program should also be produced in Spanish. Many of the residents in the low income area were unable to view the English program because they spoke only Spanish. The fact that approximately 50 percent of the population in New Mexico are of Hispanic origin lends support to having programs in both Spanish and English.

4. If the television programs are shown outside the home, it is recommended that either transportation be provided to those residents who cannot provide their own or that a variety of more convenient viewing locations be provided.

SECTION III

TESTING OF EDUCATIONAL MATERIALS WITH SOLAR ENERGY RELATED WORKERS

EFFECTIVENESS OF TELEVISION INSTRUCTION AS A DELIVERY METHOD FOR WORKERS IN A SOLAR-RELATED INDUSTRY

Introduction

The study of effectiveness of television as a delivery method for workers in solar related industries was based on two factors.

The first factor was the need for workers who understand solar energy principles. With the world supply of non-renewable energy becoming depleted, it is extremely important to utilize energy sources that are not depleted. Solar energy is, at the present time, the most feasible of the alternative energy sources. However, workers are needed which can install, repair, and maintain solar energy systems. The type of workers needed are those who may already be trained workers but merely need continuing education classes in solar energy principles.

A second factor, in the development of this study was a lack of participation in continuing education activities by a wide range of adults. Reasons often given for this lack of participation are that adults must have classes offered at a time and location which is convenient. A review of literature revealed that television had often been used to provide a delivery method which allowed adults to take advantage of educational activities at convenient times and places. However, little research had been conducted to determine if television instruction was successful with adult learners. Therefore, a study aimed at assessing the effectiveness of this medium in attracting viewers and achieving

comparable results to printed materials was undertaken.

A group of workers in a solar energy-related industry, sheet metal workers, was examined to explore the effectiveness of two media--audio-visual and print. The primary objectives of the study were to determine (1) if a program on solar energy would appeal to persons who do not, normally, participate in adult education programs; (2) if media preference will to lead to higher levels of performance; (3) if learners show greater learning from the medium with which they have had the greatest successful previous experience; and (4) if high verbal or spatial ability will provide information about performance of workers in a solar-related industry on a specific medium of instruction.

Population and Sample

An objective of this study was to learn more about persons who traditionally do not participate in adult, continuing education programs. London and Wenkert (1964) have indicated that members of labor unions seldom participate in these programs. Furthermore, few media studies have involved adults other than college students or military personnel. However, the Northern New Mexico Apprenticeships Program for Sheet Metal Workers was willing to cooperate in the study. All apprentices in the Farmington area and apprentices, journey men sheet metal workers, and materials handlers in the Albuquerque area were included in the study. The total number of participants in this portion of the study was 52, broken down as indicated in Table 19.

TABLE 19

PARTICIPATION OF SHEET METAL WORKERS

Place	Level	Number
Farmington	Apprentices	15
Albuquerque	Apprentices	25
	Journeymen and Materials Handlers	12
	Total	52

Printed Materials

The instructional materials used in the study were developed over a three-year period from 1978 to 1980. The development process is described below. The population of interest and the samples from that population are also described in this chapter. Various measurement and survey instruments were developed for use in the study. The instruments and the procedures for use of the instructional materials and data collection are outlined. Finally, the methods of data analysis used are included in this chapter.

The printed modules. In 1977-78, it was determined through a survey of manpower training needs in alternative energy areas that there was a training need in the solar energy industry (Edington, Keaton & Neberay, 1978). Employers in the construction industry and in the heating, air conditioning, and ventilation industry indicated that salesmen, installers, servicemen, and construction workers could benefit from a

course on general principles of solar energy systems. At the time, there were very few instructional materiáls available which were suitable for the learners it was believed could benefit most from such a course. In response to this perceived need, a series of seven instructional units were prepared on the subject.

As a preliminary to a literature search, project staff met with representatives of the New Mexico Energy Institute and the Arizona Solar Energy Research Commission. Also, a consulting engineer who had worked with organizations in northern New Mexico to plan training programs on solar energy systems provided materials and suggestions. A literature search was then conducted for source materials to be used in preparing the units.

The instructional units were designed for post high schcol technical education and adult education programs. The format for the units was recommended by the New Mexico State Vocational Education Division. A representative from that agency served as a consultant during the preparation of the seven units. A preliminary draft of each unit was reviewed by a representative of the New Mexico Energy Institute for technical accuracy. Finally, the modules were field tested by the Wisconsin Vocational Studies Center before publication.

Test questions had been prepared for each instructional module. Since the information in the first three instructional units corresponded to the information in the first audiovisual segment, questions were selected at random from the first three modules. These questions were reworded for use in the study.

After the test was administered to 10 volunteers, further

modifications of the test items were made. The test was then used for pretest and posttest purposes.

The audiovisual segments. In initial meetings with the representatives of the National Training Fund, the training coordinator of the sheet metal workers apprenticeship training program, and representatives from the Department of Educational Management and Development, the New Mexico Solar Energy Institute (NMSEI), and the public television station at New Mexico State University, KRWG-TV, it was planned that the 30-minute television or audiovisual segments would be based on the instructional units. The first two meetings involving representatives from the organizations listed above produced a list of objectives and outlines for the series. A third meeting was held after a list of materials required had been compiled. At this meeting, methods of presenting important concepts were discussed.

However, as the outlines developed, it was decided to include more information on domestic hot water, passive systems, and retrofit systems than appears in the printed instructional units. During the two years since the instructional units had been prepared, a great variety of mechanisms and techniques for utilizing solar energy have been developed. The opinion of the technical experts from NMSEI was that these new applications should be included to indicate the number of ways in which solar energy principles can be applied. Basic principles of solar energy were to be introduced and then a variety of applications indicated. The basic principles parallel those in the printed units. However, since the audiovisual medium is at its best in presenting materials visually, there was a move to take

advantage of the versatility of the medium to demonstrate a number of applications. The series titles were as follows: I: Basic Principles of Solar Energy Systems; II: Passive Solar Energy Systems; III: Hot Air Active Systems; IV: Liquid Active Systems; V: Retrofit Passive Systems.

A number of charts were selected and developed for the series. The graphics were developed to illustrate the major components of a specific system or subsystem. The flow of a fluid or of heat movement could be traced through the system. Thus the narrator could first explain the components and then talk the viewers through the system using a graphic display. This aspect of the use of the audiovisual medium was throught to be an important advantage of the medium over print (see Solomon, 1974). By pointing out the components; the direction of movement of heat through natural conduction, convection, or radiation or the movement of the heat transfer fluid in an active system; and the sequencing of component functions in the system while explaining how the system works, the narrator can make optimal use of the audiovisual medium. Provided an instructor has extensive graphic materials available, the same can be accomplished in face-to-face instruction but is much more difficult to effect in printed materials, where the verbal explanation is necessarily separated from the graphic presentation.

After explaining the system using a graph, the audiovisual presentation makes it possible to show an actual system accompanied by further explanation. This further dimension of the audiovisual medium--the ability to show the actual trombe wall or rock storage

bed--provides information not available in a classroom situation, although photographs can be used and explained in the classroom, or in a printed manual with accompanying written explanations.

As the graphics were planned and developed, the original outlines were modified. Finally, outline scripts were prepared which gained the approval of the technical consultants from NMSEI. At this point, it was decided to use narrators from NMSEI. It was suggested by the representative of KRWG that using narrators with technical training would provide a technical credibility which might be lacking if a nontechnical person narrated the segments.

Throughout the planning sessions, two audiences were targeted. As with the printed instructional units, the audiovisual segments were intended for use by learners in postsecondary vocational and technical programs and in adult education programs. It was believed, also, that the materials would be of interest to a general audience. It was decided that the language and technical information should be suitable for persons with an eighth-grade education. While it was expected that the audience would be composed mainly of persons with at least a high school education, that education might have been acquired some time ago. Employees or students in solar-related industries might be technically more sophisticated than a general audience but still not be highly proficient with language. On the other hand, while a general audience might have a greater language proficiency than the workers and vocational students, their technical training might be minimal. It was believed the compromise reached in order to serve both audiences would not be detrimental. The nature

of the audiovisual medium seems to require sompler language and a less complex or information-loaded message (Lumsdaine, 1963).

At each taping session, a reviewer from NMSEI checked the accuracy of the narrator's on-camera monologue. A member of the project staff was also present during all planning and taping sessions. After the tapes were edited, each segment was again reviewed by a member of NMSEI.

During the review sessions, the project staff took notes from which test items were prepared. Again the test was administered to volunteers, and modifications were made if an item seemed ambiguous or misleading. The test was used for pretest and posttest purposes.

Procedures

Both the printed materials and the audiovisual segments were provided the workers. The workers formed two groups according to geographic location: Farmington, New Mexico, and Albuquerque, New Mexico. It was decided to initiate the instructional process for one group with the printed materials and to initiate the progess for the other group with the audiovisual materials. In this way, if media preference were influenced by first media contact, this bias might be revealed. After the initial exposure, instruction was continued using both media, audiovisual and print. Pretests and posttests were administered to each group, and a final comprehensive test covering the information from the printed and audiovisual materials was given to both groups.

It should be noted that the Farmington group meets one Saturday a month for the entire day while the Albuquerque group meets one evening a week. The same instructor meets with each group.

The printed materials were used initially by the Farmington group. The apprentices were pretested and then asked to study the first three instructional modules, entitled "Using Solar Energy," "Locating the Sun," and "Solar Energy Systems." After one and one-half hours, the apprentices were retested. They were instructed to read the remaining four units at home. At the following meeting, the apprentices were shown the first two audiovisual segments. The remaining three segments were shown at the next meeting and the final comprehensive test administered. The books were distributed and studied in February 1980, at which time the pretest and posttest occurred. The audiovisual segments were shown in March and April, 1980.

After taking the final test, the participants completed a questionnaire asking their age, level of education, media preferences, and amount of time spent using the two media (see Appendix C).

The Albuquerque group were pretested and then shown the first of the five audiovisual segments, on basic principles of solar energy systems. After viewing the segments the participants were retested and the printed instructional modules were distributed. The workers were asked to read the first three units before the next meeting, the following week.

One segment was shown each week beginning in March. However, the last two segments were shown on the same evening, followed by the final comprehensive test. After the test was administered, the workers again completed the questionnaire asking about education level, media preferences, and leisure time spent reading or watching television (Appendix C).

The regional training coordinator provided scores on aptitude tests for persons in the apprenticeship program. However, scores were not available for the journeymen and materials handlers, and American Indians are accepted into the apprenticeship program without taking the tests. The aptitude tests used are the Multiple Aptitude Tests, devised by D. Segal and E. Raskin, published by the California Test Bureau (1957). Tested are aptitudes in seven areas: word meaning, paragraph meaning, arithmetic recognition, arithmetic computation, applied science, spatial two dimension, and spatial three dimension. A composite score is also available.

Instrumentation

The questionnaire (Appendix C) was developed in collaboration with another person and will be used in a research project of which this study constitutes one part. It is not expected that the information about the participants' age, sex, or education will be of value in this study, which is mainly concerned with media preference as a motivating factor in participation in adult continuing education programs. The regional training coordinator provided the exact age of all participants; all are aged between 20 and 35, the age category achieving the highest participation rates nationally. All but 3 of the 52 workers were male. Nationally, 29.2 percent of participants in adult continuing education programs were males enrolled in courses in occupational training, compared to 19.5 percent females (Boaz, 1978, p. 9). The small number of females enrolled in the apprenticeship program makes any analysis by sex impossible.

A final comprehensive test was developed for use in the study. The questions were obtained from test questions in the printed materials and from tests which had been developed for each of the audio-visual segments. The final tests required about 45 minutes to complete.

Analysis of the Data

Because of the many restrictions imposed by attempting to collect information under field conditions, the expected generalizability of these findings will be limited. However, by examining media preferences in light of the participants' performance as measured by a test, the study is of value because there will be a reduction in the degree of uncertainty in the decision making process. An examination of the literature suggests that the effects of media upon learning gain may be explained by (1) previous experiences in using the media, (2) media preference, or (3) aptitude, verbal or spatial.

Two types of data were available for the groups of workers in Farmington and Albuquerque, New Mexico. First, there were the aptitude subtest scores on three tests: the pretest, posttest, and final comprehensive test. The test scores were used as dependent variables for regression analysis, for calculating simple correlations, and in analysis of variance. Second, ordinal and classification data were obtained from the questionnaire and were tabulated or used in non-parametric analyses.

After coding the data and preparing the data cards, analysis was performed using the Statistical Package for the Social Sciences (SPSS) programs (Nie, et al., 1975). Frequency counts were obtained

for the data from the questionnaire. Group means, variances and standard deviations, and minimum and maximum scores were obtained for the aptitude tests, the pretests, posttests and final test. The aptitude tests were used in a series of t-tests to determine equivalence of the two groups. A correlation matrix (Pearson's coefficient) of all metric variables was computed; the Spearman rank correlation was computed between ordinal values and test scores. A stepwise regression analysis was performed on the aptitude test scores, using the final test score as the dependent variable. To determine if each aspect, media preference, previous experience with a specific medium of instruction, or differences in aptitude, help to explain achievement as indicated by the test scores, means and standard deviations were obtained using a one-way analysis of variance with a Cochran's C test for homogeneity of variance.

Each aspect will be examined separately for each group with information obtained from the questionnaire. For examining the influence of media preference, information from questions about time spent reading and watching television each week, and, in particular, about each respondent's preferred medium of instruction and, where possible, correlation coefficients calculated. The posttest and final test will be used as dependent variables. Learning gain will be calculated using the pretest and posttest scores and examined for each group.

The influence of previous experience with a specific medium of instruction creates serious difficulties. It was suggested in the review of the literature, one's approach to a medium may be influenced by whether the previous experience was successful or unsuccessful.

The level of education attained can be an influencing factor; however, subjective evaluations may exert a greater influence (Cronbach & Snow, 1977; Travers, et al., 1967). Data from questions about how well the respondent believed he or she did in school and concerning with which medium the respondent believed he or she learned best were examined in this light. Cross tabulations of school performance and media perceptions using mean test scores will be examined for trends which might lead to fruitful future investigation.

It has been suggested that persons with greater spatial or verbal aptitudes may learn more efficiently using a particular medium of instruction. Coefficients of correlation (r^2) will be calculated, using the final test scores and the scores on the aptitude tests, to determine if specific aptitudes are associated more closely with one medium over another (print or audiovisual).

The findings will be discussed in the next chapter. Conclusions and recommendations will be presented in Chapter 5.

Findings

The audiovisual segments and printed instructional materials were used with two classes of workers affiliated with the sheet metal apprenticeship program. One class was comprised of 15 sheet metal apprentices in the Farmington, New Mexico, area. The Albuquerque, New Mexico, group included 24 sheet metal apprentices and 13 journeymen sheet metal workers and materials handlers. Aptitude test scores were available on 14 of the apprentices from Farmington and all Albuquerque apprentices. Therefore, any analysis of variance or

regression analysis which makes use of the aptitude test scores includes the results of the apprentices only.

Some initial comparisons between the Farmington and Albuquerque groups will be useful in terms of subsequent discussions of the results for the individual groups. Five items are noted below.

First, the two groups did not differ significantly on a final test administered to each group at the completion of the course of study. The final test used questions based on both the audiovisual and printed materials. The Farmington group began by studying the first three units of the printed materials, with a pretest and posttest, followed by viewing of the audiovisual materials in conjunction with completion of the printed instructional modules, read at home. The Albuquerque group viewed the first audiovisual segment, with a pretest and posttest, followed by viewing the remaining audiovisual materials at subsequent meetings and reading the printed materials at home. The mean test scores, standard deviations, and standard errors are shown in Table 20. The number completing the final test in the Albuquerque group included 21 apprentices and 7 journeymen and materials handlers.

While the Albuquerque group has a smaller standard deviation and standard error of the mean, a t-test for difference of means indicates that any differences are attributable to chance (calculated t=.1655 with 24 degrees of freedom between the two groups of apprentices).

Table 20

Final Test

Means and Standard Deviations for Albuquerque and Farmington Groups

Group	Number	Mean	Standard Deviation	Standard Error
Farmington	15	40.47	13.20	3.41
Albuquerque				
Apprentices only	21	42.86	5.44	1.19
Total Group	28	40.00	9.90	1.87

Second, aptitude scores, for the two groups of apprentices, show no significant differences in means between the groups on any one of the tests. The tests measure abilities in seven areas: word meaning, paragraph meaning, arithmetic recognition, arithmetic computation, applied science, spatial two-dimension, and spatial three-dimension. For each training group, Table 21 shows the group mean, standard deviation and standard error on each of the aptitude tests. The differences in mean scores on the tests for paragraph meaning and applied science show the greatest differences, although these differences are not significant even at the ten percent level. The calculated F-value in Table 21 is a test for equality of variance (H_o: $\sigma_1^2 = \sigma_2^2$) (Nie, et al., 1975, p. 270). Only the difference in mean for applied science looks suspicious, but the difference is significant at a level of probability above 10 percent. Therefore, a pooled variance

Table 21

Aptitude Test Scores

Mean, Standard Deviation, F and t-Values

Farmington (1) and Albuquerque (2) Apprentices

Test and Group	Number of Cases	Mean	Standard Deviation	Standard Error	F Value	2-Tail Prob.	Pooled Variance Estimate t Value	Degrees of Freedom	2-Tail Prob.
Word Meaning									
1	14	68.6429	18.147	4.850	1.61	0.378	-0.28	36	0.781
2	24	66.6250	23.001	4.695					
Paragraph Meaning									
1	14	75.5714	21.529	5.754	1.03	0.996	1.37	36	0.180
2	24	65.5833	21.803	4.451					
Arithmetic Meaning									
1	14	69.5714	23.014	6.151	1.19	0.685	-0.92	36	0.362
2	24	76.3333	21.056	4.298					
Arithmetic Computation									
1	14	62.2143	26.283	7.024	1.14	0.759	-0.57	36	0.573
2	24	67.0417	24.643	5.030					
Applied Science									
1	14	86.9286	15.489	4.140	2.15	0.104	-1.03	36	0.309
2	24	91.2917	10.556	2.155					
Spatial Two-Dimension									
1	14	65.4286	22.944	6.132	1.05	0.890	-0.20	36	0.846
2	24	66.9167	22.421	4.577					
Spatial Three-Dimension									
1	14	70.0714	20.296	5.424	1.02	1.000	-0.09	36	0.927
2	24	70.7083	20.527	4.190					

t-test will be used. As can be seen from Table 21, there are no significant differences at even a 10 percent level.

Third, learning gains, as measured by pretest, posttest score differentials, were obtained for the two groups, with almost all individuals in both groups showing learning gains (see Appendix D). It must be remembered that there were two tests, one for the audiovisual segments and a second for the printed materials. Each test was used for pretest and posttest purposes with the group taking that test. The Farmington group was administered the test developed for the printed materials, on units 1, 2, and 3. The mean scores and mean gain are shown in Table 22. Using a sign test, the calculated

Table 22

Means for Test Scores and Mean Learning Gains on Tests of Printed Materials Farmington Group

Number	Pretest	Posttest	Learning Gain
15	14.73	22.07	7.33

$Z = 3.6$

$Z\left[\frac{(X - .5) - N/2}{\frac{1}{2}\sqrt{N}}\right]$ would occur by chance only two times out of 10,000.

The Albuquerque apprentices, journeymen, and materials handlers were administered a test developed for the first audiovisual segment. The mean scores and mean gain are shown in Table 23. Using a sign

Table 23

Means for Test Scores and Mean Learning Gain on Test of Audiovisual Materials

Albuquerque Group

Number	Pretest	Posttest	Learning Gain
28	14.73	21.70	6.97

Z = 5.1

test, the calculated Z indicates a difference even less likely to occur by chance than that obtained for the Farmington group.

Fourth, while stepwise regression analyses performed upon each group, using aptitude subtest scores as predictors of final test scores, reveals modest differences in aptitude subtest-final test linkages, these differences in the order in which the variables enter the equation do not appear sufficiently meaningful to support any hypothesis that the two groups were drawn from different populations. Summary tables showing the square of the multiple correlation coefficient obtained from the regression analysis are presented in Tables 24 and 25.

Table 24

Farmington

Multiple R^2 From Stepwise Regression Summary Table

Dependent Variable = Final Test

Variable	Multiple R	R Square	R Square Change
Paragraph Meaning	0.499	0.249	0.249
Spatial 3-Dimension	0.602	0.363	0.114
Spatial 2-Dimension	0.783	0.614	0.251
Applied Science	0.800	0.640	0.026
Arithmetic Recognition	0.806	0.650	0.011
Arithmetic Computation	0.812	0.660	0.009
Word Meaning	0.823	0.677	0.017

Table 25

Albuquerque

Multiple R^2 From Stepwise Regression Summary Table

Dependent Variable = Final Test

Variable	Multiple R	R Square	R Square Change
Spatial 3-Dimension	0.370	0.137	0.137
Spatial 2-Dimension	0.542	0.293	0.156
Arithmetic Recognition	0.576	0.332	0.039
Arithmetic Computation	0.640	0.410	0.078
Paragraph Meaning	0.666	0.444	0.034
Word Meaning	0.777	0.604	0.160
Applied Science	0.778	0.605	0.001

For the Farmington group, 67.7 percent of the variation in final test scores can be explained by the aptitude subtest scores. For the Albuquerque group, 60.5 percent of the variation in final test scores can be explained by scores on the aptitude subtests.

Fifth, with regard to simple Pearson coefficients of correlation between single subtests and final test, it was found that the verbal subtests were most highly correlated with posttest ($r = .495$ for word meaning, $r = .499$ for paragraph meaning). The Pearson coefficients of correlation for the Albuquerque group, between single subtests and final tests were weakest. Arithmetic recognition ($r = .293$) and arithmetic computation ($r = .250$) showed the highest correlations with

final test score for the Albuquerque group. Having noted these descriptive characteristics for the two samples, it is time to turn to the study's objectives pertinent to this portion of the analysis. Three objectives are of interest here:

1. to determine if media preference will lead to higher levels of performance as measured by a test;

2. to determine if learners show greater gains, as measured by achievement on a test, from the learning medium with which they have had the greatest successful previous experience; and

3. to determine if high verbal or spatial ability, as measured by an aptitude test, will provide predictive information about performance of workers in solar-related industries on a specific medium of instruction (audiovisual or print).

Media preference. It is of interest to determine if media preference is associated with learning gain. Previous studies with college students and military personnel have been inconclusive in establishing such an association (Campeau, 1974; Nasser & McEuen, 1976). Each group was asked to indicate a media preference (book or television) but were given the option of selecting instructor (see Appendix C). The subjects were instructed to select only one of the three possible choices, but a number of respondents indicated a preference for a combination. The results, using posttest and final test scores, are shown below. In Table 26, two groups are compared using final test score as the dependent variable.

As can be seen from Table 26, face-to-face instruction was generally preferred over either instructional medium or combination of medium and instruction. On the final test, however, those preferring the book received higher mean scores than those preferring either the audiovisual medium or face-to-face instruction. It must be noted that the highest mean score on final test was achieved by the five Albuquerque respondents who insisted on a mix of the two media plus instructor. It is also important to note that those groups obtaining the highest mean scores on the posttest did not necessarily achieve the greatest mean learning gain. For the Farmington group, there is no correlation between posttest and learning gain (the Spearman rho = 0.015); the Spearman rho (r_s) for the final test with learning gain was -0.126. The r_s for the Albuquerque group for posttest with learning gain was 0.322; but the r_s for learning gain with final test was 0.128.

Table 26

Media Preference

Means and Standard Deviations on Test Scores

for Two Groups of Sheet Metal Workers

Group	Dependent Variable	Media Preference: Television	Book	Instructor	Television with Instruction	Book and Instructor	All Three	Book and Television
Farmington								
	Learning Gain							
	n=	4	3	6	1	1	—	—
	$\bar{x}$=	8.75	7.67	6.00	6.00	10.00		
	s=	.50	.58	3.79	—	—		
	Posttest							
	$\bar{x}$=	22.25	22.67	21.83	20.00	23.00		
	s=	2.87	1.15	4.83	—	—		
	Final Test							
	n=	4	3	6	1	1		
	$\bar{x}$=	41.00	45.00	40.67	25.00	39.00		
	s=	9.49	17.52	15.82	—	—		
Albuquerque								
	Learning Gain							
	n=	4	1	13	4	1	4	2
	$\bar{x}$=	6.25	7.00	7.15	8.25	2.00	6.50	4.50
	s=	2.75	—	4.02	7.63	—	5.20	0.71
	Posttest							
	$\bar{x}$=	19.75	22.00	21.77	22.25	19.00	23.25	22.50
	s=	2.87	—	4.82	6.24	—	2.50	4.95
	Final Test							
	n=	3	1	9	3	2	5	1
	$\bar{x}$=	34.67	42.00	39.67	43.33	28.00	47.60	34.00
	s=	18.01	—	8.63	9.29	17.68	3.21	—

It is of interest to note that for the Farmington group, the greatest learning gain was shown for the subset preferring television, although the highest scores on the posttest and final test were achieved by those preferring the book. The Albuquerque group does not present such a clear picture. The highest mean learning gain was achieved by the group preferring television plus face-to-face instruction. There is very little difference among the subsets on the posttest scores; with final test, those preferring television plus instructor achieved the second highest mean score.

The respondents were also asked to indicate the number of hours spent per week reading or watching television. The means for learning gain, posttest and final test on these variables are shown for the Farmington group in Tables 27 and 28. The posttest scores give little information here, for the differences in mean scores between groups is negligible. The Farmington group, it should be remembered, began by reading the first three units of the book, with a pretest and posttest, and then proceeded by reading the book and viewing the audiovisual segments. Also, the Farmington group had the higher scores on word meaning and paragraph meaning on the aptitude subtests, although a t-test comparing the group's scores with those of the Albuquerque group did not indicate a significant difference.

Table 27

Hours of Reading

Means and Standard Deviations on Test Scores

Farmington

Score		Hours per Week: Less than 1	1-5	6-10	More than 10
Learning Gain	n=	1	9	4	1
	$\bar{x}$=	9.00	8.11	5.75	5.00
	s=	—	2.57	2.87	—
Posttest	$\bar{x}$=	24.00	22.33	20.50	24.00
	s=	—	2.06	5.74	—
Final Test	$\bar{x}$=	32.00	39.33	43.75	46.00
	s=	—	12.07	19.29	—

Table 28

Hours of Television

Means and Standard Deviations on Test Scores

Farmington

Score		Hours per Week: Less than 5	6-10	11-20	More than 20
Learning Gain	n=	6	6	3	
	$\bar{x}$=	6.83	7.00	9.00	
	s=	2.32	3.03	3.00	
Posttest	$\bar{x}$=	23.33	20.67	22.33	
	s=	1.03	4.80	2.08	
Final Test	$\bar{x}$=	45.33	37.33	36.00	
	s=	14.42	11.92	14.93	

The data in Tables 27 and 28 suggest that there is an inverse relationship between hours spent reading and hours spent watching television. Furthermore, the data suggest an inverse relationship between hours spent reading and learning gain and mean score on the final test. While the mean scores on the final test increase as number of hours spent reading per week increases, there is a reverse trend for mean learning gain; the greatest learning gain was achieved by a respondent who indicated a reading time per week of less than one hour.

The opposite holds for time spent watching television. Learning gains increased in direct relation to the number of hours spent watching television per week. Again the posttest scores show little variation; however, the means for final test scores are highest for those who watch the least number of hours per week. These results bring hypotheses about viewer literacy (see Olson, 1974) into question.

However, the data for the Albuquerque group provide a slightly different picture. First, as can be seen in Tables 29 and 30, more respondents spend a moderate amount of time both reading and watching television, rather than engaging more in one activity or the other. Increases in learning seem to be associated positively with greater number of hours per week spent reading and with fewer hours per week spent watching television. While the Farmington apprentices showed higher mean learning gains with fewer hours spent reading per week, the Albuquerque respondents showed slightly higher mean learning gains with greater time spent reading per week.

Another difference can be seen in Table 29 as compared to

Table 29

Hours of Reading

Means and Standard Deviations on Test Scores

Albuquerque

Score		Hours per Week			
		Less than 1	1-5	6-10	More than 10
Learning Gain	n=	7	13	7	2
	$\bar{x}$=	6.71	7.00	7.57	7.00
	s=	5.06	3.72	4.96	7.07
Posttest	n=	7	13	7	2
	$\bar{x}$=	21.86	21.85	20.71	24.00
	s=	4.63	4.00	4.27	7.07
Final Test	n=	5	9	8	2
	$\bar{x}$=	48.60	38.56	40.00	26.00
	s=	2.61	12.36	5.69	14.14

Table 30

Hours of Television

Means and Standard Deviations on Test Scores

Albuquerque

Score		Hours per Week			
		Less than 5	6-10	11-20	More than 20
Learning Gain	n=	6	11	8	4
	$\bar{x}$=	8.33	8.09	5.25	6.00
	s=	3.83	4.23	3.81	6.16
Posttest	n=	6	11	8	4
	$\bar{x}$=	49.50	23.45	21.50	20.75
	s=	3.94	2.91	4.78	6.02
Final Test	n=	4	9	6	5
	$\bar{x}$=	28.50	41.67	44.50	41.20
	s=	16.92	9.06	6.16	4.92

Table 30. On mean score on final test for the reading subgroups, the highest scores for the Albuquerque group were achieved by the respondents who indicated that they read less than one hour per week, while for the Farmington group higher scores were obtained by respondents who spent six to ten hours per week reading.

The same inverse trends occur with regard to the number of hours spent watching television each week. While mean learning gains increased as number of hours spent watching television increased for the Farmington group, the reverse occurred with the Albuquerque participants, i.e., as number of hours spent watching television decreased, mean learning gains (an average of posttest minus pretest scores) increased. A reverse trend can also be seen with the final test mean scores. The Albuquerque apprentices who said they watched more than ten hours of television per week scored higher on the final test than those viewing less than five hours per week, while mean scores for the Farmington group decreased as number of hours of television viewing per week increased. A look at the correlation coefficients in Table 31 demonstrates this graphically.

Spearman's rho (r_s), a nonparametric correlation coefficient, was obtained for the two variables, hours psent reading per week and hours spent watching television per week. The statistic, a rank-order correlation coefficient $[r_s = 1 - \frac{6\sum_{i=1}^{m} d_i^2}{N^3 - N}]$ does not depend upon a normal distribution and can be used with numeric, ordinal data (Nie, et al., 1975).

Table 31

Correlation Coefficients (r_s)

Albuquerque and Farmington Sheet Metal Apprentices

Group and Variable	Hrs. Reading/Wk.	Hrs. Television/Wk.
Albuquerque		
Learning Gain	0.0804	-0.2133
Final Test	-0.5880	0.1465
Farmington		
Learning Gain	-0.5484	0.2944
Final Test	0.2856	-0.2820

While some of the correlations are too low to have any significance, the inverse patterns and the large differences do suggest interactions which many not be explained by variations between the groups due to aptitude. It may be that the effect is associated in some way with whether the subject matter was first introduced by printed instructional materials or by audiovisual instructional materials.

It is difficult to determine if media preference bears a relationship to learning achievement for the groups tested. The majority of respondents in both groups preferred face-to-face instruction; yet the mean learning gains for this method of instruction are lower than average for the Farmington group (the group mean for learning gain was 7.334 while the mean for those with a stated pre-

ference for face-to-face instruction was 6.00). On the other hand, the group mean for learning gain for all Albuquerque participants was 6.72; thus, those in the Albuquerque group preferring face-to-face instruction had a mean score (7.15) well above the average for the Albuquerque group. Yet the mean score on the final test (the only score on which the two groups can be directly compared) for the Albuquerque group was slightly below that of the Farmington group, although the difference is not significant using a t-test (calculated $t = .025$).

With regard to the respondents' current use of the two media employed in the study as media of instruction, the interactions by media make further analysis difficult. Whether these differences are influenced by the medium through which each group was initially exposed cannot be determined here.

Previous school experience. It was suggested in the literature that previous successful experience with a specific media might be a better predictor of how well a learner would perform using a particular media in the future than other variables researchers had examined (Cronbach & Snow, 1977; Travers, et al., 1967). We have already seen that media preference is not closely associated with higher learning gains or higher scores as measured by a test. Participants in the study were asked if they thought they did well in school (school performance). The response was a forced choice "yes" or "no". A second question asked which medium of instruction the respondents believed they learned most from (learned with). Three choices were provided, television, book, or instructor. As with questions pertaining

to media preference, the participants were instructed to mark only one choice; however, in a number of cases, the participants chose a combination of at least two of the three choices.

There is little correspondence between respondents' stated media preferences and the instructional medium or method with which they believed they had learned most (see Table 32). In the Albuquerque group, 15 of 31 respondents selected a different medium, i.e., preferred one medium but believed they learned best with a different medium or method. Eight of the 15 Farmington apprentices differed on the two

Table 32

Choices Regarding Media or Method of Instruction

Media	Albuquerque		Farmington	
	Learned With	Preference	Learned With	Preference
Television	2	5	--	4
Book	4	1	1	3
Instructor	22	15	11	5
Television & Instructor	1	2	1	2
Book & Instructor	2	2	2	1
All Three	--	4	--	
Book & Television	--	2	--	

variables. In the last section, means for each media choice were compared. A similar comparison was attempted for the medium the respondents believed they learned best with in Table 33. However,

the response to this question resulted in an almost unanimous choice of face-to-face instruction. With so little dispersion, any attempts to generalize are impossible.

Table 33

Respondents' Perception of Medium with Which Learned Best

Group & Score		Media, Method, or Combination				
		Television	Book	Instructor	Television & Instructor	Book & Instructor
Farmington						
Learning Gain	n=	--	1	11	1	2
	$\bar{x}$=	--	7.00	7.18	6.00	9.00
	s=	--	--	3.03	--	1.41
Posttest	$\bar{x}$=	--	24.00	21.82	20.00	23.50
	s=	--	--	3.72	--	0.71
Final Test	$\bar{x}$=	--	46.00	41.18	25.00	41.50
	s=	--	--	14.66	--	3.54
Albuquerque						
Learning Gain	n=	3	4	18	1	2
	$\bar{x}$=	6.00	6.25	8.00	2.00	7.00
	s=	2.65	3.20	4.55	--	7.07
Posttest	$\bar{x}$=	21.00	20.75	21.67	29.00	22.50
	s=	4.36	3.59	4.43	--	4.95
Final Test	n=	1	3	16	1	2
	$\bar{x}$=	51.00	28.00	42.44	36.00	33.00
	s=	--	12.17	7.36	--	24.04

Also examined was how well the subjects believed they did in school. The respondents were asked if they thought they did well in school, to which they could respond "yes" or "no". The results are shown in Table 34. In both groups those who believed they did not do well in school actually achieved higher mean learning gains and higher mean test scores.

Table 34

Respondents' Perceptions of School Performance

Group and Score			Did Well	Did Poorly
Farmington	Learning Gain	n=	13	2
		$\bar{x}$=	6.85	10.50
		s=	2.48	2.12
	Posttest	$\bar{x}$=	21.85	23.50
		s=	3.48	0.71
	Final Test	$\bar{x}$=	40.31	41.50
		s=	13.46	16.26
Albuquerque	Learning Gain	n=	16	10
		$\bar{x}$=	6.31	7.80
		s=	4.19	4.54
	Posttest	$\bar{x}$=	20.88	23.60
		s=	4.59	3.53
	Final Test	n=	12	10
		$\bar{x}$	37.08	46.50
		s=	10.17	6.06

On each mean score shown in Table 34, those who indicated a belief that they did poorly in school achieved higher scores. A one-way analysis of variance using final test as the dependent variable obtained a significant F-ratio (5.393, P = .03). However, since the study deals with populations, using F-ratios to make inferences is inappropriate.

A cross tabulation of school performance by medium with which the respondents learned best and by preferred medium provides some insight (see Tables 35 and 36). The data for the Farmington apprentices provide very little information on school performance because so few perceived themselves as having done poorly in school. With regard to media preference, among those in the Farmington group who said they did well, the highest scores were obtained by those who preferred the book (Table 35); however, face-to-face instruction also showed relatively high mean scores.

Table 35

School Performance by Media Preference on Mean for Final Test Score

School Performance		Media Preference						
		Television	Book	Instructor	Television and Instructor	Book and Instructor	All Three	Book and Television
Farmington								
Did Well	n =	4	3	3	2	0	1	--
	$\bar{x}$ =	34.50	48.67	45.33	35.50	--	39.00	--
	s =	6.18	9.98	5.73	10.50	--	--	--
Did Poorly	n =	1	0	1	0	0	0	0
	$\bar{x}$ =	53	--	30	--	--	--	--
Albuquerque								
Did Well	n =	2	0	8	1	1	1	0
	$\bar{x}$ =	28.50	--	39.37	33.00	41.00	50	--
	s =	14.50	--	8.08	--	--	--	--
Did Poorly	n =	1	--	4	--	--	3	1
	$\bar{x}$ =	47.00	--	45.25	--	--	47.67	34.00
	s =	--	--	5.54	--	--	2.19	--

Table 36

School Performance by Medium Learned Best With on Mean for Final Test Score

School Performance		Medium Learned With						
		Television	Book	Instructor	Television and Instructor	Book and Instructor	All Three	Book and Television
Farmington								
Did Well	n =	0	1	9	1	2	0	0
	$\bar{x}$ =	--	46.00	41.10	25.00	41.50	--	--
	s =	--	--	14.47	--	12.50	--	--
Did Poorly	n =	--	--	2	--	--	--	--
	$\bar{x}$ =	--	--	41.50	--	--	--	--
	s =	--	--	11.50	--	--	--	--
Albuquerque								
Did Well	n =	0	2	10	0	1	0	0
	$\bar{x}$ =	--	25.00	39.60	--	50	--	--
	s =	--	11.00	7.53	--	--	--	--
Did Poorly	n =	0	1	6	1	0	0	0
	$\bar{x}$ =	--	34.00	48.17	36.00	--	--	--
	s =	--	--	2.41	--	--	--	--

Although the responses were spread among the categories on media preference, the majority of respondents indicated face-to-face instruction when asked which they learned best with; other than observing the shift in choice, there is little more to be said because of the small numbers involved. It is of interest that, for the Albuquerque group, with reference to Table 36, the highest mean scores for the Albuquerque group were, on the whole, obtained by those who believed that they did poorly in school and that they learned more from face-to-face instruction.

Correlation of aptitude with test scores. It has been suggested that certain media may be more effective in interacting with the aptitudes of the learners than others (Campeau, 1974; Cronbach & Snow, 1977; Snow & Solomon, 1968). Using Pearson's coefficient, correlations of scores on the aptitude subtests with final test scores were obtained (see Table 37).

Table 37

Correlation of Aptitude Subtest Scores with Final Test Scores

Group Test	Word Meaning	Paragraph Meaning	Arithmetic Recognition	Arithmetic Computation	Applied Science	Spatial 2-Dimension	Spatial 3-Dimension
Farmington	.4949	.4993	-.0925	.2995	-.0957	.3317	-.3791
Albuquerque	.0967	.2298	.2934	.2572	.1652	.1949	.0573

The overall mean score on final test is practically equivalent for the Farmington group ($\bar{x}$ = 40.47) and the Albuquerque group ($\bar{x}$ = 40.00), although the Albuquerque group showed a smaller standard deviation. Furthermore, the regression analysis indicated that a large amount of the variation could be explained by the aptitude subtest scores (see Table 37). Table 21 presented the mean scores on aptitude tests for the two groups of apprentices. While there were some differences, between the two groups by aptitude, none were significant even at the 10 percent level, using t-tests for differences of means.

As can be seen in Table 37, there is greater fluctuation in the correlation coefficients obtained for the Farmington group; however, only the correlations for word meaning, paragraph meaning and spatial three-dimension subtests show a meaningful but low correlation. Insofar as there may be a treatment effect, it would appear that the audiovisual media taps the aptitudinal dimensions more uniformly than does the book presentation.

Summary of Findings

Learning by a preferred medium (print or audiovisual) does not appear to lead to greater learning gains. Furthermore, neither previous learning experience with a media nor familiarity with a medium, as judged by time spent in watching television or reading, appear to lead to greater learning with that medium. Nor do specific aptitudes appear to be significantly more highly correlated with learning using one medium over another. However, it is clear that significant learning

gains can be achieved using either television or print.

Recommendations

1. It is recommended that audiovisual materials be used for the dissemination of information about solar energy and comparable technical subjects. In light of the learning gains shown irregardless of media, it would appear that there is no reason not to use an audiovisual approach to the dissemination of information about solar energy. The moderately high interest in these kinds of programs detected by the survey indicates that such programs are marketable. Since these programs are both effective and marketable, cost-benefit considerations should lead educational planners to follow the recommendation.

2. Media selection should be addressed with a view to overcoming reluctance based on past experience. The study of the sheet metal workers demonstrates that persons who perceive themselves as having done poorly in school can learn from televised instruction. If a means could be devised whereby more persons had the benefit of this kind of successful learning experience, their report of this experience could go a long way toward overcoming negative expectations in other persons who share their life situation.

3. In light of the findings, educational planners must know more about the targeted learners' subjective perceptions about which media they learn best with and how well they did in school. However, this recommendation leads us on to contemplate areas for further needed research.

Need for Further Research

1. Further research is needed to determine whether and to what

extent individual learning is affected by the media through which a subject is introduced. While the mean performance of the two study groups were comparable, the patterns of associations which emerged at several points in the study suggest that certain individuals may respond differentially to media.

2. Further research is needed to determine whether, in the case of mixed mode presentations, different orders of media use will produce different results.

3. Subjective self-descriptions, for the Albuquerque group, appeared to be moderately good predictors of final test performance. Further study to determine the degree of reliance which can be placed on using self-descriptions as a basis for making decisions about media are needed.

SECTION IV

TESTING OF TELEVISION WITH VOCATIONAL CLASSES IN SOLAR ENERGY RELATED SUBJECTS

EFFECTIVENESS OF TELEVISION INSTRUCTION IN TEACHING SOLAR ENERGY PRINCIPLES TO POSTSECONDARY VOCATIONAL STUDENTS

Introduction

In the late 1960's, experts and concerned citizens began to predict that petroleum and other non-renewable energy sources would be in short supply in the near future. These predictions, coupled with the oil embargo of 1973, have brought to the attention of the American people the realities of short energy supplies. This awakening has led to efforts to assess the nation's energy needs. As it becomes more evident that the United States is extremely dependent on non-renewable energy sources which are rapidly diminishing, much interest has been expressed in alternative energy sources. Of these alternative sources, solar energy for heating homes and domestic hot water appears to be the one which is the most immediately feasible.

New Mexico is a state with high potential for the use of solar energy systems (Grant, 1977) and therefore is in need of workers in the solar energy field. In a study of manpower training needs for alternative energy sources, it has been projected that approximately 450 persons will be employed by the solar energy industry in New Mexico within the next five to ten years (Edington, Keaton, and Neberay, 1978). Employers in construction industries and representatives of building trades in New Mexico have indicated a desire for training materials for workers who might construct solar homes or install and maintain solar devices across the state.

The expressed need for workers and training clearly points to a demand for vocational and continuing education programs in the field

of solar energy. Training programs and materials are needed in order to meet the vocational needs of individuals engaged in the solar energy industry.

The question of curriculum for workers in the solar energy industry in New Mexico has, to a large degree, been answered. Keaton and Edington (1978) have developed a printed instruction guide which has been accepted by the industry as a factual and valid curriculum guide for teaching principles of solar energy to workers in the construction field. However, the question of how to teach the material included in the guide is still unanswered. A unique problem in providing a delivery system for the information is the distance involved. Individuals needing training in solar energy principles are in small groups throughout New Mexico. What is needed is a delivery system which can be used by vocational and continuing education to effectively educate adults in a "long distance" fashion.

McBride (1976) has called television instruction the "teaching at a distance system." If evidence were available that television learning could be effectively used to provide postsecondary vocational and continuing education students with solar energy information, this pedogogical technique could then be used to meet the training needs of workers in the solar energy industry in New Mexico.

Purpose

The basic purpose of this study was to seek answers to the following questions:

1. How effective is television instruction in providing vocational students with information on solar energy principles?

2. What are the attitudes of students enrolled in postsecondary vocational courses toward television instruction for learning solar energy principles?
3. Do adults of varying educational levels score differently on tests over solar energy depending on whether they receive television or regular instruction?
4. Do adults of varying age levels score differently on tests over solar energy depending on whether they receive television or regular instruction?

Need for the study

The need for the study was based upon consideration of the following factors:

1. There is a need for alternative energy sources for heating homes and domestic hot water in New Mexico as well as throughout the United States.
2. A need now exists for workers who will be installing and maintaining solar devices.
3. Vocational and continuing education classes are presently training the type of workers who will need solar energy instruction. However, a long distance delivery method is needed which can be used to effectively train workers and future workers in solar principles.
4. Research is needed to determine how effective television instruction can be in training adult workers in solar energy principles.

5. A study has not been found which focused on determining attitudes toward television instruction of vocational students entering occupations needing solar energy instruction.

Population and Sample

The target populations for the study consisted of students enrolled in two vocational classes in two postsecondary institutions in New Mexico. Students enrolled in two solar energy related classes at the Dona Ana Branch of New Mexico State University in Las Cruces, New Mexico (Dona Ana) were one population. The two classes were heating/ventilation/air conditioning and building trades. There were fifteen participants enrolled in the building trades class and fourteen in heating/ventilation/air conditioning.

Students enrolled in solar energy related classes at the Clovis Branch of Eastern New Mexico University (Clovis) were the second population in the study. The two classes were bricklaying and carpentry. There were nineteen participants enrolled in the bricklaying class and eighteen in carpentry.

Design

The study was a quasi-experiment. Elements of two research designs were incorporated in the development of a design for the study. The Interrupted Time Series (Cook and Campbell, 1979) allows the use of two nonequivalent groups, each receiving the treatment at different times. When one group receives the treatment of interest, the other group receives the traditional treatment. In this manner, one group serves as a control while another group receives the treatment, and

then the process is reversed. The design can be diagrammed as follows with O representing pretests and posttests, X representing treatment, and the dotted line indicating nonequivalent groups:

$$\begin{array}{l} O_1\ O_2\ O_3\ O_4\ O_5\ O_6\ O_7\ O_8\ O_9\ O_{10}\ O_{11} \\ \text{----------} \\ O_1\ O_2\ O_3\ O_4\ O_5\ O_6\ O_7\ O_8\ O_9\ O_{10}\ O_{11} \end{array}$$

(p. 223)

The design was strengthened by incorporating the Equivalent Materials Design (Campbell and Stanley, 1966), which can be diagrammed as follows with O indicating a test and $M_{ax}...M_{nx}$ representing different materials for the same treatment:

$$M_aX_1O \quad M_bX_oO \quad M_cX_1O \quad M_aX_oO$$

(p. 46)

The design used in the study incorporated both of the above designs into one which could be diagrammed as follows:

$$\begin{array}{l} O_1M_aXO_2\ \ O_3\ \ O_4\ \ O_5M_cXO_6\ \ O_7\ \ O_8\ \ O_9MeXO_{10} \\ \text{----------} \\ O_1\ \ O_2\ \ O_3M_bXO_4\ \ O_5\ \ O_6\ \ O_7M_dXO_8\ \ O_9\ \ O_{10} \end{array}$$

Cook and Campbell (1979) stated that the Interrupted Time Series Design is an extremely strong design which controls for the threats to internal validity and has potential to extend external validity. The Equivalent Materials Design controls for all threats to internal validity but is lacking in external validity. The design used in the study, which incorporated both designs, further strengthened both internal and external validity.

Procedure

The treatment of interest was television instruction. A series of five, thirty minute television programs on solar energy principles

comprised the television instruction (see Appendix A for description of programs). In order to determine the class to initially receive television instruction, a coin was tossed. This random method determined that the heating/ventilation/air conditioning class at Dona Ana would receive Unit I on solar energy instruction by television.

A pretest was given to the heating/ventilation/air conditioning class. The class then viewed the videotape "Unit I, Introduction to Solar Energy Principles and Practices". A posttest covering material in Unit I followed.

During this same period, the building trades class received a pretest. The regular instructor then taught the introduction to solar energy principles and practices in the manner in which classroom instruction of this class was generally conducted. The building trades class then took a posttest over the material in Unit I.

On the second day, the heating/ventilation/air conditioning class received a pretest on material to be covered in "Unit II, Passive Solar Systems". This class (which had viewed Unit I on television) then received regular classroom instruction on passive solar systems. A posttest on material covered was then taken by the building trades class. On this same day, the building trades class received a pretest on Unit II, viewed television instruction on Unit II, and took a posttest following Unit II.

This switching technique was utilized for "Unit III, Active Air Systems," "Unit IV, Active Liquid Systems," and "Unit V, Retrofit Systems". Each group received a pretest, instruction by television or regular instructor, and a posttest.

During the same time period, this same procedure was used with the bricklaying and carpentry classes at Clovis.

Data and Instrumentation

The specific nature of the subject matter contained in the five units on solar energy principles necessitated pre- and posttests covering specific solar energy principles. Therefore, five instruments were developed by the researcher and an educator experienced in development of solar energy tests (see Appendix E for examples of the instruments). These instruments were used as pre- and posttests to collect data from the vocational students participating in the study.

Another instrument for collecting data concerning participant attitude toward the television instruction was also developed by the researcher and educator (see Appendix E). This instrument was administered to participants following the completion of the five solar energy units.

The instruments used in the study reflect much of the material from previous instruments which are printed in Understanding Solar Energy Systems (Keaton and Edington, 1978). These instruments are printed non-standardized instruments which were adapted and updated to reflect material covered in the five units on solar energy used in the present study. The instruments were reviewed by experts in solar energy and education for content validity. The unit tests were field tested by the Wisconsin Vocational Studies Center.

Following development, unit tests were pilot tested with vocational building trades classes at the Las Cruces High School. The

pilot test was used to check clarity of instructions, appropriateness of questions, and to collect comments concerning other factors which might affect results obtained.

Content validity of the five solar energy instruments was reviewed and analyzed by vocational teachers teaching solar energy related courses. The names of these individuals are found in Appendix H. In addition, the attitude instrument was reviewed and critiqued by graduate assistants in the Department of Educational Management and Development at New Mexico State University during the Spring, 1980 semester.

Analysis

Data were transferred to computer cards and analyzed, utilizing facilities at the Computer Center at New Mexico State University. A detailed explanation of how the data were coded is found in Appendix D. The computer program used in the statistical analysis was the Statistical Package for the Social Sciences (Nie, et al., 1975).

Descriptive statistics were used to summarize the data pertaining to characteristics of the participants. Frequency counts and percentages were calculated for the descriptive data from the groups of participants from the two institutions. The variables of age, hours spent watching television, hours spent reading, amount of formal education, and the amount of learning resulting from the television series were all reported as ordinal data. Enjoyment of the television series, preference of mode of instruction, and willingness to recommend the television series to others were all nominal variables.

A Cochran's C test was performed on the data to determine homogeneity of variance between the groups for each analysis. No significant differences in the variances of the groups were found.

Multiple regression analysis was used to determine if there was a significant relationship among variables. Independent variables were the pretest score on each unit, age of participants, educational level of participants, and type of instruction (the treatment). The pretest score was calculated as number of correct responses and therefore, was interval data. Age and educational level of participants were reported as ordinal data. A hierarchial multiple regression analysis of the posttest scores was performed on (1) pretest scores, (2) level of formal education, (3) age, and (4) type of instruction. The regression analysis was performed for both the Dona Ana and Clovis groups.

Regression analysis indicated that age and formal education of the Dona Ana group were not significantly influencing the posttest scores. However, the regression analysis indicated that the pretest scores for Dona Ana were significantly related to the posttest scores. To account for the influence of pretest scores on posttest scores, participants were blocked into two groups (high and low). To determine high and low groups, the median score on the pretest was used as a dividing point. A one-way analysis of variance was performed within each group to determine if there were significant differences between those receiving television instruction and those receiving regular instruction. An analysis of variance was performed for Unit I through Unit V.

The regression analysis for the Clovis group also indicated a significant relationship between pretest and posttest scores. For Unit II and Unit V the regression analysis also indicated a significant relationship between formal education and posttest scores.

In order to hold constant the influence of pretest scores on posttest scores, participants from Clovis were blocked into two groups using the median score to place participants in either a high or low group. A one-way analysis of variance was then performed on Unit I, III, and IV to determine significant differences between groups which received different methods of instruction.

An analysis of covariance was performed for Units II and V using formal education as the covariate. The analysis of covariance was used to control the influence of formal education on posttest scores and therefore determine the influence of type of instruction on posttest scores.

FINDINGS

Characteristics of Participants and Attitudes Toward Television Instruction

Characteristics of vocational students who served as participants are reported in this section. All participants were enrolled in post-secondary vocational classes at either the Dona Ana Branch of New Mexico State University (Dona Ana) or the Clovis Branch of Eastern New Mexico University (Clovis).

Also reported in this section are the attitudes of vocational students toward television instruction. To determine attitudes toward television instruction, participants were asked to respond to questions on the "Attitude Instrument" (see Appendix E).

Attitudes of participants as well as data related to characteristics of participants are reported for participants from Dona Ana and Clovis. In addition to information for each separate group, data are reported for the combined group. The combined group represents the total number of participants from both institutions.

Age of Participants

As a group the participants were young with half of them being in the 18-30 age group (see Table 38), and no participants in the older age category of over 55. The majority of participants from Clovis were divided into two age groups with almost half in the 18-30 age group and 40 percent in the 41-55 age group. There were no participants in the under 18 age group from Dona Ana and less than 14 percent in the 41-55 age category.

TABLE 30

AGE OF PARTICIPANTS

Age of Participants	Percentage of Students By Institution		
	Dona Ana (n=29)	Clovis (n=37)	Combined (n=66)
Under 18	0.0	2.7	1.5
18-30	51.7	48.6	50.0
31-40	34.5	8.1	19.7
41-55	13.8	40.5	28.8
Over 55	0.0	0.0	0.0
Total	100.0	100.0	100.0

Hours Spent Watching Television

When asked the number of hours per week of watching television 42 percent of all participants reported watching 5-10 hours per week (see Table 39). Most of the Dona Ana group reported watching 5-10 hours of television per week while less than 4 percent reported watching more than 20 hours per week. Participants from Clovis were more evenly divided into categories on this characteristic as about one third reported watching television less than 5 hours per week; slightly less than one third reported watching 5-10 hours, and almost one third watched 11-20 hours per week.

TABLE 39

HOURS PER WEEK OF TELEVISION WATCHING

Hours/Week of Television Watching	Percentage of Students By Institution		
	Dona Ana (n=29)	Clovis (n=37)	Combined (n=66)
Less than 5	24.1	32.4	28.8
5-10	62.1	27.0	42.4
11-20	10.3	29.7	21.2
More than 20	3.4	10.8	7.6
Total	100.0	100.0	100.0

Hours Per Week of Reading

A wide variety of reading habits were indicated by the group. Table 40 shows almost 24 percent of the combined group reported reading more than 10 hours per week while 41 percent reported reading from 1-5 hours per week. Only 11 percent of the Dona Ana group indicated they read less than one hour per week.

TABLE 40

HOURS PER WEEK OF READING

Hours/Week of Reading	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=37)	Combined (n=63)[a]
Less than 1	11.5	16.2	14.3
1-5	42.3	40.5	41.3
6-10	23.1	18.9	20.6
More than 10	23.1	24.3	23.8
Total	100.0	100.0	100.0

[a] There were 3 missing cases.

Formal Education

In general the participants had a high school education or beyond (see Table 41). Only 15 percent of the Dona Ana group and only slightly over 8 percent of the Clovis group indicated having less education than completion of high school. Having attained more than a B.S. degree was indicated by less than 8 percent of the Dona Ana group and by less than 3 percent of the Clovis group.

TABLE 41

FORMAL EDUCATION

Formal Education	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=37)	Combined (n=63)[a]
Some high school	15.4	8.1	11.1
High school graduate	38.5	54.1	47.6
Some college	30.8	24.3	27.0
Certificate program completion or associate degree	7.7	10.8	9.5
College graduate	0.0	0.0	0.0
More than BS degree	7.7	2.7	4.8
Total	100.0	100.0	100.0

[a] There were 3 missing cases.

Rating of Learning from Television Series

A large majority of the participants (87.3 percent) reported learning from the television series on solar energy (see Table 42). Over half of the participants from Dona Ana and Clovis reported learning a moderate amount while almost 35 percent of the Dona Ana group and 16 percent of the Clovis group indicated learning a great amount from the series. Less than 13 percent of the combined group indicated learning only a small amount or nothing from the series.

TABLE 42

RATING OF LEARNING AS A RESULT OF THE TELEVISION SERIES

Learning from Television Series	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=37)	Combined (n=63)[a]
Learned nothing	0.0	5.4	3.2
Learned a small amount	3.8	13.5	9.5
Learned a moderate amount	61.5	64.9	63.5
Learned a great amount	34.6	16.2	23.8
Total	100.0	100.0	100.0

[a]There were 3 missing cases.

Enjoyment of Television Series

Almost 70 percent of the participants enjoyed the television series (see Table 43). When asked if they enjoyed the series, 73 percent of the Dona Ana group and close to 68 percent of the Clovis group reported in the affirmative.

Preferred Mode of Learning

The instructor was reported as the preferred mode of learning by 60 percent of all participants (see Table 44). Television was rated by 38.5 percent of those from Dona Ana and 23.5 percent from Clovis as the preferred mode of learning solar energy principles. Less than 18 percent of the Clovis participants and none of the Dona Ana group preferred learning from a book to television or an instructor.

TABLE 43

ENJOYMENT OF TELEVISION SERIES

Did you Enjoy the Television Series?	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=37)	Combined (n=63)[a]
Yes	73.1	67.6	69.8
No	26.9	32.4	30.2
Total	100.0	100.0	100.0

[a]There were 3 missing cases.

TABLE 44

PREFERRED MODE OF LEARNING

Preferred Mode of Learning	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=34)[a]	Combined (n=60)[b]
Television	38.5	23.5	30.0
Book	0.0	17.6	10.0
Instructor	61.5	58.8	60.0
Total	100.0	100.0	100.0

[a]There were three missing cases

[b]There were six missing cases.

Recommendation of Television Series

Most of the participants indicated that they would recommend the series to others (see Table 45). When asked if they would recommend the television series to others, over 78 percent of the Clovis participants and 73 percent of those from Dona Ana indicated that they would.

TABLE 45

RECOMMENDATION OF TELEVISION SERIES

Would you Recommend the Television Series to Others?	Percentage of Students By Institution		
	Dona Ana (n=26)[a]	Clovis (n=37)	Combined (n=63)[a]
Yes	73.1	78.4	76.2
No	26.9	21.6	23.8
Total	100.0	100.0	100.0

[a]There were 3 missing cases.

Regression Analysis

To determine if there was a significant relationship between (1) pretest scores, (2) level of formal education, (3) age, and (4) type of instruction; a hierarchial multiple regression analysis of the posttest scores was performed on these four variables for both the Dona Ana and the Clovis group.

Dona Ana

Regression analysis revealed that age and formal education of the Dona Ana group were not significant factors to consider in

determining the influence of level of instruction on posttest scores. However, Tables 19-28 (Appendix G) indicate that pretest scores were significantly related to posttest scores. Therefore, pretest scores had to be taken into account before interpretation of posttest results could be made.

Clovis

Regression analysis for the Clovis group also revealed a significant relationship between pretest and posttest scores (see Appendix G for regression tables). In addition, for this group, there was also a significant relationship between formal education and posttest scores on Unit II and Unit V.

Analysis of Variance

Dona Ana

To account for the influence of pretest scores on posttest scores (as indicated by the multiple regression analysis), the participants were blocked into two groups (high and low). The median score on the pretest was used as the determinate of whether a score was high or low. A one-way analysis of variance was then performed within each group to determine significant differences between those who received television instruction and those who received regular instruction.

Unit I

Table 46 reveals that individuals with high scores on the pretest who received television instruction scored significantly higher on the posttest for Unit I than did their counterparts with high scores who received regular instruction. Individuals with low scores on the pretest

who received television instruction also scored higher on the posttest than those in the low pretest score group who received regular instruction, but the difference was not significant.

TABLE 47

ANOVA OF POSTTEST SCORES OF DONA ANA PARTICIPANTS ON UNIT I BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	20.29	15.33	*6.47
Low	16.57	14.67	.90

*Significant at .05 level

Unit II

There were slightly higher scores in both the high and low pretest score groups by individuals receiving television instruction on Unit II than those receiving regular instruction (see Table 47). However, these differences were not significant.

TABLE 47

ANOVA OF POSTTEST SCORES OF DONA ANA PARTICIPANTS ON UNIT II BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORES

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	15.43	15.17	.05
Low	14.50	14.38	.02

*Significant at .05 level

Unit III

On Unit III, the mean scores for the high pretest group were the same for those receiving television instruction and those receiving regular instruction (see Table 48). However, there was a significant difference between those in the low pretest score group receiving television instruction and those receiving regular instruction. The mean score for those in the low group receiving television instruction was significantly higher than that of those receiving regular instruction.

TABLE 48

ANOVA OF POSTTEST SCORES OF DONA ANA PARTICIPANTS ON UNIT III BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	16.00	16.00	0.0
Low	15.50	11.80	*18.36

*Significant at .05 level.

Unit IV

There were no significant differences in the posttest scores for Unit IV of either the high or the low pretest score group regardless of whether they received television or regular instruction (see Table 49).

TABLE 49

ANOVA OF POSTTEST SCORES OF DONA ANA PARTICIPANTS ON UNIT IV BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	14.00	12.85	.34
Low	10.67	11.00	.02

*Significant at .05 level

Unit V

Both the group with high pretest scores and the group with low pretest scores who received television instruction had higher posttest scores than those receiving regular instruction (see Table 50). However, neither of these differences were significant.

TABLE 50

ANOVA OF POSTTEST SCORES OF DONA ANA PARTICIPANTS ON UNIT V BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	14.75	12.00	4.45
Low	10.67	9.89	.35

*Significant at .05 level.

Clovis

Because of the relationship between pretest scores and posttest scores found through multiple regression techniques, the participants from Clovis were blocked into two groups with the median score on the pretest being used to determine the two levels of the blocking variable. A one-way analysis of variance was performed (with the two exceptions noted below) to determine significant differences between the groups which received different methods of instruction.

For Units II and IV, an analysis of covariance was performed using formal education as the covariate. This analysis was used as a means of controlling for the influence of formal education which was found to be significant in the multiple regression analysis for these units.

Unit I

The high pretest group receiving television instruction on Unit I had higher mean posttest scores than did those receiving regular instruction (see Table 51). However, these differences were not significant. Those with low pretest scores who received television instruction had only slightly higher scores than those receiving regular instruction and these differences were not significant.

Unit II

Analysis of covariance performed on the posttest scores for Unit II revealed that when formal education was controlled, those in the

TABLE 51

ANOVA OF POSTTEST SCORES OF CLOVIS PARTICIPANTS ON UNIT I BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	18.67	15.80	3.42
Low	13.67	13.75	.00

*Significant at .05 level.

high pretest group receiving television instruction still scored significantly higher on the posttest than those in the high pretest score group receiving regular instruction. For the low pretest score group, those who had television instruction did not score significantly higher on the posttest than those who received television instruction when differences due to formal education were adjusted through analysis of covariance (see Table 52).

TABLE 52

ACOVA OF POSTTEST SCORES OF CLOVIS PARTICIPANTS ON UNIT II BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE AND FORMAL EDUCATION AS A COVARIATE

Score on Pretest	Method of Instruction TV	Regular	F Ratio Covariate	F Ratio Main Effects	F Ratio Explained
High	15.57	11.88	1.21	*14.32	*7.77
Low	13.70	13.50	*7.39	.07	*3.73

*Significant at .05 level.

Unit III

Table 53 reveals that individuals with high scores on the pretest who received television instruction scored significantly higher on the posttest for Unit III than those with high pretest scores who received regular instruction. Individuals with low pretest scores who received television instruction also scored significantly higher on the posttest than those in the low pretest score group who received regular instruction.

TABLE 53

ANOVA OF POSTTEST SCORES OF CLOVIS PARTICIPANTS ON UNIT III BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	15.00	10.67	*14.33
Low	14.89	10.64	*14.21

*Significant at .05 level.

Unit IV

Individuals in both high and low pretest score groups who received television instruction made slightly higher posttest scores on Unit IV than did their counterparts who received regular instruction (see Table 54). However, these were not significant differences for either the high or low pretest score group.

TABLE 54

ANOVA OF POSTTEST SCORES OF CLOVIS PARTICIPANTS ON UNIT IV BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE

Score on Pretest	Method of Instruction TV	Regular	F Ratio
High	11.00	10.75	.03
Low	10.44	10.33	.01

*Significant at .05 level

TABLE 55

ACOVA OF POSTTEST SCORES OF CLOVIS PARTICIPANTS ON UNIT V BY METHOD OF INSTRUCTION WITH BLOCKING ON PRETEST SCORE AND FORMAL EDUCATION AS A COVARIATE

Score on Pretest	Method of Instruction TV	Regular	F Ratio Covariate	F Ratio Main Effects	F Ratio Explained
High	13.50	10.00	.02	*5.89	2.96
Low	11.44	9.92	1.34	2.32	1.83

*Significant at .05 level

Unit V

Analysis of covariance performed on the posttest scores for Unit V indicated that when formal education was held constant, those in the high pretest score group receiving television instruction still scored significantly higher on the posttest than those in the high pretest group who received regular instruction (see Table 55). Those in the low pretest score group who received television instruction made higher posttest scores than those in the low group who received regular instruction but the difference was not significant.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The Problem

The study was designed to provide answers to the following questions:

1. How effective is television instruction in providing vocational students with information on solar energy principles?
2. What are the attitudes of students enrolled in post-secondary vocational courses toward television instruction for learning solar energy principles?
3. Do adults of varying educational levels score differently on tests over solar energy depending on whether they received television or regular instruction?
4. Do adults of varying age levels score differently on tests over solar energy depending on whether they received television or regular instruction?

Hypotheses

Following a review of the literature and related research, the following hypotheses were developed:

Hypothesis 1. Adults receiving television instruction will have as high or higher scores on tests over solar energy than adults which receive regular instruction.

Hypothesis 2. Adults receiving television instruction will have positive attitudes towards television instruction.

Hypothesis 3. Adults of varying educational levels will not

have significantly different scores on tests over solar energy.

Hypothesis 4. Adults of varying age levels will not have significantly different scores on tests over solar energy.

Procedure

The two populations for the study consisted of vocational students enrolled in two post-secondary institutions in New Mexico. One population consisted of students enrolled in building trades and heating/ventilation/air conditioning classes at the Dona Ana Branch of New Mexico State University (Dona Ana). A second population were students enrolled in bricklaying and carpentry at the Clovis Branch of Eastern New Mexico University (Clovis).

The treatment of interest was television instruction comprised of a series of five television programs on solar energy. A pretest was first given to the heating/ventilation/air conditioning class at Dona Ana. The class then viewed the Unit I videotape. A posttest covering material in Unit I followed. During this same period, the building trades class at Dona Ana recieved a pretest. The regular instructor then taught the introduction to solar energy principles and practices in the manner in which instruction was generally conducted. The building trades class then took a posttest on the material in Unit I.

On the second day, both classes received a pretest over material to be covered in Unit II. The class which had viewed Unit I on television then received regular classroom instruction and the class previously receiving regular instruction received television instruction. Both classes then received a posttest over material in Unit II.

This switching technique was utilized for the remaining units and each group received a pretest and posttest on material from each unit. During the same period, the same procedure was used with bricklaying and carpentry classes at Clovis.

Pre- and posttests for the five solar energy units were developed by the researcher and an educator experienced in development of solar energy tests. A second researcher-developed instrument for collecting data concerning participant attitude toward television instruction was also administered to participants following completion of the series.

Summary of Findings

The findings, as they relate to individual hypotheses, are as follows;

Hypothesis 1. As a means of controlling for the influence of pretest scores, participants were divided into high and low groups according to pretest score, and analysis of variance was then used to determine significant differences between those receiving television instruction and those receiving regular instruction.

With the exception of one unit, every Dona Ana group (both high and low pretest scores) receiving television instruction had higher scores (and in one case the same score) as those receiving regular instruction. The one exception was that the lower pretest score group receiving regular instruction scored slightly higher than those receiving television instruction on Unit IV.

In two cases (Unit I and Unit IV), Dona Ana participants

receiving television instruction scored significantly higher than did those receiving regular instruction. On Unit I, the high pretest score group receiving television instruction scored significantly higher than those receiving regular instruction who had scored high on the pretest. On Unit III, those in the low pretest score group who received television instruction scored significantly higher than their counterparts who received regular instruction.

The means of the Clovis group receiving television instruction (both high and low pretest score groups) were higher than those receiving regular instruction in every case except one. On Unit I, the lower pretest score group receiving regular instruction did slightly better on the posttest than those receiving television instruction.

After analysis of covariance was utilized to control for the influence of formal education on Unit II and Unit V in the Clovis group, there were significant differences between television instruction and regular instruction on Units II, III, and IV. Those who received television instruction in the high pretest score group had significantly higher scores on Units II, III, and V. On Unit III, those with low pretest scores receiving television instruction scored significantly higher than those receiving regular instruction.

Hypothesis 2. A large majority of the participants reported that they learned from the television series. Very few participants indicated that they had learned only a small amount or nothing from the series. Most of the participants stated that they would recommend the series to others.

Almost 70 percent of the participants enjoyed the television series. However, 60 percent of all participants preferred the instructor to television or a book as a method of learning solar energy. Very few participants preferred learning from a book.

Hypothesis 3. Multiple regression revealed that formal education was not significantly related to posttest scores of the Dona Ana group. However, regression analysis revealed a significant relationship between the formal education of the Clovis group and their scores on two of the posttests.

Hypothesis 4. Multiple regression revealed that age was not significantly related to posttest scores of either the Dona Ana group or the Clovis group.

Conclusions

The following conclusions were based on interpretations of the data presented in the study and are limited to the two groups used in the study:

1. When the factors of age, formal education, and pretest scores are held constant, adults receiving television instruction have as high or higher scores on tests over solar energy than adults receiving regular instruction.
2. Adults receiving television instruction have positive attitudes toward television instruction. Participants stated that they had learned from the series, they did enjoy it, and they would recommend the series to others.
3. Adults prefer instructors as a method of learning rather

than television.

4. Adults prefer television as a method of learning rather than a book.
5. When formal education was held constant, participants still had as high or higher scores on tests over solar energy.
6. Adults of varying age levels do not have significantly different scores on tests over solar energy regardless of whether they receive instruction by television or regular classroom methods of instruction.

Recommendations

The following recommendations are made by the researcher as a result of having conducted this study:

1. Postsecondary vocational programs which prepare solar energy related workers should consider using television instruction as a method of providing workers with necessary solar energy principles.
2. Television instruction should be considered a viable means of providing a long distance delivery system for individuals living a distance from educational institutions. Television instruction could be particularly appropriate where branch campuses are located a distance from the main campus.
3. Television instruction should be considered as a means of providing continuing and update education at times and places convenient to participating adults.

4. When attempts are made to include adults of varying educational levels in educational endeavors, television instruction should be considered as a possible delivery method.
5. Television instruction should be used more widely in planning and conducting educational activities for adults of varying age levels.
6. Further research is needed to determine if television instruction can be cost-effective in providing educational experiences for citizens of New Mexico.

SECTION V

SUMMARY
OF PROJECT

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This project consisted of three separate studies conducted to determine the effectiveness of television instruction on solar energy principles. Each of these studies is described in sections II, III, and IV of the report. Section I describes the instructional materials used in the project.

The three studies conducted as part of this research project were undertaken to determine the effectiveness of television as a delivery method for dissemination of solar energy information. Each of these studies is briefly described in this section. Following the description of each study, conclusions and recommendations are made for the use of television instruction in New Mexico.

All three studies used the television series on solar energy which is described in Appendix A.

Effectiveness of Television Instruction as a Delivery Method for the General Public

Within the state of New Mexico and across the nation, interest in lifelong learning and adult, continuing education is growing. However, studies of those participating in adult and continuing education in the United States indicate that by far the majority of this participation is from younger, white, more highly educated, white collar or professional workers, and those from higher income households. When surveyed to determine lack of participation, adults give as barriers time, cost, and distance.

Television instruction has been used extensively in other countries

and appears to have potential in breaking down some of the barriers prohibiting widespread adult participation in continuing education. Therefore, a study to determine if television is likely to increase participation and knowledge, and if sufficient learning occurs to merit the cost of producing the learning materials seemed worthwhile.

The study of television with the general public consisted of two parts. First, a survey was conducted to determine the number of people watching the program on solar energy and their occupational status. To obtain this information, a random sample of households in Las Cruces, New Mexico, was surveyed.

Second, an attempt was made to determine if the videotaped instructional program on solar energy enhanced knowledge for residents from various income levels. A random sample of residents from high, medium, and low socioeconomic levels was surveyed to assess their knowledge level concerning solar energy. Another random sample of residents from each socioeconomic level was shown the television series.

The televised segments had appeal for a general audience. Lower income households and non-English speaking households were not as well represented as other groups.

All residents, regardless of income level, had a significant increase in knowledge after viewing the television series.

Effectiveness of Television Instruction as a Delivery Method for Workers In A Solar-Related Industry

The study of effectiveness of television as a delivery method for workers in a solar related industry was based on the need for workers who understand solar energy principles. A second factor in the

development of the study was a lack of participation in continuing education activities by a wide range of adults. According to the literature review, it appeared that television instruction could solve these problems. Therefore, a study was conducted to determine how effective television could be in providing solar energy information to workers.

The primary objectives of the study were to determine (1) if a program on solar energy would have appeal to persons not usually participating in adult education programs; (2) if media preference would lead to higher levels of performance; (3) if learners show greater learning from the medium with which they have had greatest successful previous experience; and (4) if high verbal or spatial ability will provide information about performance of workers in a solar-related industry on a specific medium of instruction.

All apprentices in the Farmington area and apprentices, journeymen sheet metal workers, and materials handlers in the Albuquerque area were included in the study. These workers were given a pretest, shown the television series, and given a posttest to determine solar energy knowledge.

Significant learning gains were achieved regardless of method used. Learning by a preferred medium (print or audiovisual) does not appear to lead to greater learning gains. Neither previous learning experience with a medium nor familiarity with a medium appear to lead to greater learning from the medium.

Effectiveness of Television Instruction In Teaching Solar Energy Principles To Postsecondary Vocational Students

The research was based on the need for a delivery system for

solar energy instruction for vocational and continuing education classes. A delivery system was needed which had the potential of providing instruction in New Mexico and similiar states where there were large distances between students and educational institutions as well as between main and branch campuses.

Although television instruction had been used in various countries to provide educational activities to isolated areas and provide instruction in areas of new technology, limited research concerning its effectiveness had been done in the United States. Research which had been conducted had not focused on the effectiveness of television instruction in vocational classes.

The study utilized vocational classes from two postsecondary institutions in New Mexico. Two solar energy related classes from each of these institutions were used to test the effectiveness of television instruction in providing solar energy information. The purpose of the study was to determine (1) how effective television instruction is in providing vocational students with information on solar energy; (2) the attitudes of adults to television instruction; and (3) if adults of varying educational and age levels score differently on tests over solar energy depending on whether they receive television or regular instruction.

The study, a quasi-experiment, involved two nonequivalent groups each receiving television instruction at different times. As one group received television, the other group received regular instruction. Pre- and posttests were given to determine effectiveness of each method of instruction. Attitudes concerning television instruction were determined

by the use of a participant-completed instrument administered following instruction.

When the factors of age, formal education and pretest scores were held constant, participants receiving television instruction had as high or higher scores on tests over solar energy as participants receiving regular instruction. The adults participating in the study stated that they enjoyed the series, learned from it, and would recommend it to others. Television instruction was preferred over either regular or book instruction.

It was recommended that postsecondary vocational programs preparing solar energy related workers consider using television instruction. Television instruction was recommended as a means of providing a long distance delivery system to enable vocational, continuing, and update students to more actively participate in educational activities. Television was recommended as a means of enabling adults of varying educational and age levels to participate in educational activities.

Further research was suggested in order to determine if television instruction could be cost effective in providing educational experiences for citizens in New Mexico.

Conclusions

Individuals who viewed the television series on solar energy enjoyed the series. Members of the general public as well as workers and future workers in classes indicated positive attitudes toward the series. Members of the general public who know the series was being broadcast did watch the program. However, the appeal of the television series was not as strong for members of the lower socioeconomic or education levels.

As television units on solar energy are more widely available perhaps more people in all socioeconomic and education levels will accept solar energy for heating and cooling as a viable solution to energy problems.

Solar energy information provided in a language readily understandable to individuals could be much more valuable than information provided in a second language or a language not understood. In New Mexico, particularly, language may be an important barrier to continuing education participation for low income residents.

Individuals watching the program also reported that they had learned about solar energy from the television series. Scores on tests validated their opinions as significant learning gains were achieved based on the results of viewers on pre- and posttests over solar energy.

Regardless of age, formal education, or income level, participants increased their knowledge of solar energy after viewing the programs. In addition, a large majority of all individuals surveyed, enjoyed the television series and felt they learned from it. It appears, then, that a televised instructional program could be used to disseminate

solar energy information to all residents in New Mexico. The effectiveness of the dissemination could be greatly enhanced if the barriers of language and availability of transportation are overcome.

Recommendations

Based on the findings of the three studies, the following recommendations are made for the use of television and solar energy instruction in New Mexico.

1. It is recommended that television instruction be used for the dissemination of information about solar energy and comparable technical subjects in New Mexico. In light of the learning gains shown irregardless of media, it would appear that there is no reason not to use an audiovisual approach to the dissemination of information about solar energy. The moderately high interest in these kinds of programs detected by the survey indicates that such programs are marketable. Since these programs are both effective and marketable, cost-benefit consideration should lead educational planners to follow the recommendation.

2. In distributing the budget for televised instruction, more money should be committed to advertising the programs. Of 156 households that were contacted, only 23 of the respondents knew the program was being broadcast. Of those 23 households, the program was being watched in 13 homes.

3. To adequately disseminate information on solar energy to the general public in New Mexico, the television program should also

be produced in Spanish. Many of the residents in the low income area were unable to view the English program because they spoke only Spanish. The fact that approximately 50 percent of the population in New Mexico are of Hispanic origin lends support to having programs in both Spanish and English.

4. If the television programs are shown outside the home, it is recommended that either transportation be provided to those residents who cannot provide their own or that a variety of more convenient viewing locations be provided.

5. Media selection should be addressed with a view to overcoming reluctance based on past experience. Persons who percieve themselves as having done poorly in school can learn from televised instruction. If a means could be devised whereby more persons had the benefit of this kind of successful learning experience, their report of this experience could go a long way toward overcoming negative expectations in other persons who share their life situation.

6. In light of the findings, educational planners must know more about the targeted learners' subjective perceptions about which media they learn best with and how well they did in school.

7. Postsecondary vocational programs which prepare solar-energy related workers should consider using television instruction as

a method of providing workers with necessary solar energy principles.

8. Television instruction should be considered a viable means of providing a long distance delivery system for individuals living a distance from educational institutions. Television instruction could be particularly appropriate where branch campuses are located a distance from the main campus.

9. Television instruction should be considered as a means of providing continuing and update education at times and places convenient to participating adults.

10. When attempts are made to include adults of varying educational levels in educational endeavors, television instruction should be considered as a possible delivery method.

11. Television instruction should be used more widely in planning and conducting educational activities for adults of varying age levels.

Further Research Needed

1. Further research is needed to determine whether and to what extent individual learning is affected by the media through which a subject is introduced. While the mean performance of the two study groups were comparable, the patterns of associations which

emerged at several points in the study suggest that certain individuals may respond differently to media.

2. Further research is needed to determine whether, in the case of mixed mode presentations, different orders of media use will produce different results.

3. Subjective self-descriptions, for the Albuquerque group, appeared to be moderately good predictors of final test performance. Further study to determine the degree of reliance which can be placed on using self-descriptions as a basis for making decisions about media are needed.

4. Further research is needed to determine if television instruction can be cost-effective in providing educational experiences for citizens of New Mexico.

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APPENDIX A

DESCRIPTION OF SOLAR ENERGY UNITS

The solar energy units used for testing television instruction were titled, "Understanding Solar Energy Systems." "Understanding Solar Energy Systems" is a series of videotapes developed by New Mexico State University's Department of Educational Management and Development and the New Mexico Solar Energy Institute. It was produced by KRWG-TV on the NMSU campus and was funded by a grant from the New Mexico Board of Educational Finance and the National Fraining Fund for the Sheet Metal and Air Conditioning Industry. The five one-half hour videotapes were developed as an educational tool for the building trades and the series was televised for the general public by KRWG-TV.

Unit 1, "Basic Solar Energy," discusses energy conscious design. It includes an explanation of conduction, convection, and radiation, concepts essential to solar design. This unit presents an overview of direct gain systems, an active system and a hybrid system, accompanied by illustrations of actual homes that employ these design.

Unit 2, "Passive Systems," contains a description of five passive space heating systems: direct gain, thermal storage wall, sunspace, roof pond and a convective loop or thermosyphon system, each with illustrations.

Unit 3, "Active Air Systems," includes an explanation of how active air space heating works and how an active system can be used for water heating. Advantages and disadvantages of the system are illustrated.

Unit 4, "Active Liquid Systems," presents a discussion on collectors such as flat plate, concentrating/tracking and trick-down

systems. A flat plate liquid collector is constructed, piece by piece, with a discussion on why each piece is important. Once again, homes are used to illustrate each of the collectors. The conclusion gives advantages and disadvantages of an active liquid system.

Unit 5, "Retrofits," describes ways to adapt a building to a more energy conscious design through retrofits. Greenhouses, window box retrofits, trombe walls and drum walls are discussed as retrofit devices. In addition, retrofit water heating systems are illustrated.

The videotapes are available for viewing through the New Mexico Solar Energy Institute, New Mexico State University, Las Cruces, New Mexico, 88003. Copies may be purchased at cost from, Production Manager, KRWG-TV, Box 3J, New Mexico State University, Las Cruces, New Mexico 88003.

APPENDIX B

TELEPHONE INTERVIEW QUESTIONNAIRE

Telephone No. Called _____

I am a student doing a survey for a class at New Mexico State. Could I ask for just a few minutes of your time to get answers to several questions? [If a child answers, ask to speak to their mother or father.]

1. Is any one in your house watching TV now?

   Yes ___ [Go to 2]

   No___ [Go to 6]

2. Did you watch the program on solar energy that was shown on Channel 22 tonight, or Channel 3 on cable?

   Yes ___ [Go to 3]

   No ___ [Go to 6]

3. How many watched the program? ___

4. What are their ages? _____

5. What are their sexes? Male 0 1 2 3 ___ Female 0 1 2 3 ___

6. Did you know a program on solar energy was being shown?

   Yes ___

   No ___

Now, for classification purposes, I need to ask you some background information.

[If the respondent objects: I promise that the answers you give will be kept confidential. Your number was selected at random and I don't even know your name.]

7. What is the occupation of the head of your household?

   _____

   Retired ___

   Unemployed ___

8. What is the highest degree, diploma, or certificate received by the head of the household?

   Some high school ___ College graduate ___

   High School Graduate ___ More than B.S. degree ___

   Certificate program completion or associate degree ___ Other ___

9. [If no one was watching TV] What is your age?

   16-25 ___
   25-35 ___
   35-55 ___
   55-65 ___
   Over 65 ___

10. Sex of respondent [Fill in]

    Male ___

    Female ___

That's all I need to ask you. Thank you for helping me on my project.

APPENDIX C

PERSONAL PREFERENCE, EDUCATIONAL LEVEL QUESTIONNAIRE

DIRECTIONS: Please read each question carefully. Place a check in the blank to the left of the response which you feel best answers the question.

1. What age are you?

___ Under 18
___ 18-30
___ 31-40
___ 41-55
___ Over 55

2. What sex are you?

___ Male
___ Female

3. How much formal education have you had?

___ some high school
___ high school graduate
___ some college
___ certificate program completion or associate degree
___ college graduate
___ more than B.S. degree

4. Did you do well in school?

___ Yes ___ No

5. In school, did you think you learned more from reading a book, by watching television, or by having an instructor explain the subject?

___ Television ___ Book ___ Instructor

6. How many hours per week do you spend watching television?

___ less than 5
___ 5-10
___ 11-20
___ more than 20

7. How many hours per week do you spend reading? (Newspapers, books, magazines, etc.)

___ less than 1
___ 1-5
___ 6-10
___ more than ten

8. Would you rather learn about solar energy by reading a book, by watching television, or by having an instructor explain solar energy?

___ Television ___ Book ___ Instructor

APPENDIX D

LEARNING GAINS FOR FARMINGTON AND ALBUQUERQUE GROUPS

A. FARMINGTON

STUDENT NO.	PRETEST	POSTTEST	GAIN	FINAL
01	14	22	8	27
02	19	24	5	46
03	13	23	10	39
04	14	23	9	53
05	19	24	5	52
06	16	24	8	44
07	15	24	9	32
08	14	22	8	62
09	12	24	12	30
10	09	18	9	35
11	21	24	3	61
12	17	24	7	46
13	14	23	9	38
14	10	12	2	17
15	14	20	6	25
MEAN =	14.73	22.07	7.33	40.47

B. ALBUQUERQUE

STUDENT NO.	PRETEST	POSTTEST	GAIN	FINAL
16	13	18	5	49
17	17	21	4	44
18	00	00	-	00
19	00	00	-	45
20	26	00	-	43
21	09	20	11	36
22	12	23	11	45
23	25	00	-	41
24	00	00	-	47
25	18	20	2	46
26	15	22	7	42
27	13	24	11	52
28	00	00	-	31
29	00	00	-	36
30	13	19	6	43
31	13	25	12	45
32	27	29	2	36
33	20	27	7	35
34	13	26	13	46
35	21	26	5	00
36	18	25	7	00
37	15	24	9	47
38	15	20	5	41

STUDENT NO.	PRETEST	POSTTEST	GAIN	FINAL
39	24	26	2	50
40	08	14	6	00
41	13	14	-1	00
42	19	26	7	51
43	15	19	4	34
44	7	19	12	16
45	15	25	10	22
46	15	13	-2	33
47	15	18	3	00
48	11	19	8	00
49	9	24	15	00
50	8	21	13	00
51	16	26	10	50
52	13	18	5	14
MEAN =	15.41	21.70	6.97	40.00

APPENDIX E

INSTRUMENTS

UNIT I - INTRODUCTION TO SOLAR ENERGY PRINCIPLES AND PRACTICES

I. Decide which of the statements in the column on the right correctly defines each term given in the column on the left. Write the number of this statement in the blank to the left of each solar-related term.

___ 1. Passive System

___ 2. Energy Conscious Design

___ 3. Thermal Mass

___ 4. Active System

___ 5. Conduction

___ 6. Berm

___ 7. Convection

___ 8. Hybrid System

___ 9. Radiation

a. Heat transfer can occur in a vacuum as heat moves from a warmer to a cooler body.

b. A combination system in which the house is used for collection and storage but fans are used rather than natural heat transfer for distribution.

c. The solar energy reaching the surface of the earth.

d. Tiled floors and cement walls are used to store heat.

e. Heat moves in a solid fluid without visible motion of the solid.

f. The structure does the collection, storage and distribution.

g. Naturally occuring source of energy.

h. Minimizes winter heat loss and summer heat gain.

i. Warm air rises and is replaced by cooler air.

j. Solar energy stored in organic materials is released through chemical processes.

k. The collectors are on the roof, and heat is circulated with pumps and fans.

l. The inside floor level is below the outside level of the soil.

Unit I (continued)
Page 2

II. Place an "X" in front of the statements below which are true.

___ a. South-facing windows can be of value in a solar-heated house and still not cause cooling problems in the summer.

___ b. In the winter less energy is available from the sun because of the distance the sunlight must travel through the atmosphere.

___ c. Sound energy conscious design suggests that evergreen trees be planted on the south side of the house.

___ d. A solar energy system must collect, store, and distribute heat from the sun.

___ e. Roof overhangs are of little value in solar design.

___ f. Solar constant refers to the presence of diffuse radiation which is consistently available during the daylight hours to heat buildings.

___ g. Convection and radiation are the only natural means of heat transfer.

___ h. Heat loss can be minimized by use of air lock entries and interior chimneys.

___ i. As it travels through the atmosphere, energy is absorbed and scattered by dust, ozone, and water vapor.

___ j. Two rules of heat movement are that fluid always rises and that heat always moves to a warmer surface.

___ k. Direct gain is associated with passive systems.

III. Select the best or most correct answer and write the letter corresponding to that answer in the space provided by each item.

___ 1. Factors in energy conscious design include, among other things,

a) building materials
b) nearness of electricity and gas lines.
c) a and b
d) none of the above

____ 2. How much solar energy is available for use in a solar energy system depends upon

a) having a sun calculator.
b) being outside the atmosphere.
c) the time of day and the season.
d) the number of particles in the atmosphere.
e) c and d

____ 3. Important elements in a passive solar energy system are

a) very small windows protected by evergreen plantings.
b) windows on the north and west side of the building.
c) a and b
d) none of the above

____ 4. An active system differs from a passive system because

a) the collectors are on the roof.
b) forced convection is used.
c) the structure is used to collect and store the heat but fans and other mechanical devices are used to operate the system.
d) a and b
e) all of the above

_____ 5. Convection, a natural means of heat transfer, takes place

a) when heat is transferred from a warmer body to a cooler body.
b) when warm air rises and is replaced by cooler air.
c) when a mechanical device is used to blow cold air across a warm surface.
d) none of the above.

UNIT II --PASSIVE SOLAR SYSTEMS

I. Select the best or most correct answer and write the letter corresponding to that answer in the space provided by each item.

___ 1. Passive systems provide heating and cooling by

a. the use of fans.
b. natural means such as the sun, climate and plants.
c. the use of motors.
d. none of theses
e. all of these

____ 2. An advantage of passive systems is

a. the installation of passive systems is the same in all parts of the United States.
b. that electrical motors used are simple.
c. the low operating cost.
d. that house location makes little difference.

____ 3. A sunspace refers to

a. an area of a building which is much warmer than other parts of the building.
b. an area outside a building used to collect heat.
c. a greenhouse or atrium.
d. a small area on the roof of a building which collects more radiation than other areas.

____ 4. A passive house should be built

a. on a street running north and south.
b. at least 40 degrees off South.
c. on a street running east and west.
d. any of these
e. none of these

____ 5. An overhang on the south side of a house

a. keeps winter sun from entering a building.
b. allows radiation from the sun to enter a building in the summer so it can be stored for energy.
c. allows winter sun to penetrate building and therefore, provide heat.
c. provides more radiation when the sun is high in the sky.

___ 6. A Trombe wall

a. is placed on the north side of a building for best results.
b. can be constructed of cinder block filled with concrete to add mass.
c. stores heat which is then distributed throughout the house by means of pumps and fans.
d. all of these
d. none of these

___ 7. An example of passive solar buildings are

a. Direct Gain.
b. Drumwall.
c. Roof Pond.
d. none of these
e. all of these

___8. A thermosyphon hot water system is powered by

a. water.
b. electric pumps and fans.
c. the sun.
d. b and c
e. none of these

___ 9. A convective loop is a system which uses

a. plastic bags filled with water to store heat.
b. plants and fountains to provide heat and moisture.
c. collector panels on a roof.
d. none of these
e. all of these

II. Place an "X" in front of the statements below which are true.

___ a. A passive solar building can be placed as much as 20 degrees off South without losing much in efficiency.

___ b. Insulating shutters can be used in a passive design to reduce heat loss at night.

___ c. A Trombe wall uses large containers of water to store heat.

___ d. Insulation is needed in a greenhouse to prevent heat loss.

___ e. To be most effective, a greenhouse should be installed on the north side of a building.

____ f. No great amount of heat loss is caused if the shutters on a roof pond building remain open at night.

____ g. Reverse syphoning in a convective loop is prevented by the use of dampers.

____ h. The wire mesh is used in a convective loop to increase the surface area, which allows more efficient heating of the air.

____ i. Plastic can be installed in a convective loop to prevent reverse syphoning from the rock bed at night.

____ j. To remain comfortable in a passive solar building, it is usually necessary to open the insulating shutters during the daytime.

III. Below is a diagram of a thermal storage wall. Label the parts indicated and indicate the direction of air flow through the vents (6 points).

1. a._____

   b._____

   c._____

2. Use arrows to indicate, in the diagram, the direction of air flow, and label each direction appropriately.

3. One important feature is missing from the building. What is it?_____

   _____

UNIT III--ACTIVE AIR SYSTEMS

I. Place an "X" in front of the statements below which are true.

____ a. For best year-round performance of a collector, collector tilt should be less than the latitude.

____ b. Efficiency of collector operation will be affected if seals are damaged during installation.

____ c. The glazing on the collector reduces heat loss back to the atmosphere.

____ d. Insulation should be placed between the absorber plate and the channels in which the air moves.

____ e. In an active air system, house orientation is of little importance because house surfaces are extensive.

____ f. Air flow from the collectors to storage is the reverse of air flow from storage to the living space.

____ g. In rock storage, there must be air spaces at the points where air enters and exits the rock bed.

____ h. When hot air from the collectors enters the rock storage, the heated air moves naturally throughout the entire rock bed.

____ i. Unlike an active liquid system, the ductwork for an active air system need not be airtight or weather-proof.

____ j. The volume of the rock bed must be about three times greater than the volume for a liquid storage container.

II. Select the best of most correct answer and write the letter corresponding to that answer in the space provided by each item.

____ 1. For best performance during the winter, collector tilt should be:

a) less than the latitude.
b) latitude - 15 degrees.
c) equal to the latitude.
d) latitude + 15 degrees.

____ 2. A disadvantage of active air systems is

a) the tendency to freeze in winter.
b) the higher cost of air systems.
c) the amount of energy required to blow air through ducts.
d) when the air system leaks, the building can be damaged.
e) b and c

_____ 3. In a collector, glazing is used to

a) make a surface reflect light.
b) limit heat loss.
c) allow radiation to enter the collector.
d) b and c
e) none of the above

_____ 4. The size of rocks used in a rock bed

a) should be 3/4 to 1 1/2 inches in diameter.
b) has little to do with efficiency.
c) should be 1/4 to 4 inches in diameter.
d) none of the above

____ 5. The general rule for the amount of storage needed per square foot of collector is

a) .01 to .10 cu. ft./sq. ft. of collector
b) .5 - 1 cu. ft./sq. ft. of collector.
c) 5 - 10 cu. ft./sq. ft. of collector.
d) none of the above.

____ 6. Some advantages of active over passive systems are

a) that active systems are more complicated.
b) that active systems are not as expensive as passive systems.
c) that active systems provide better control of temperatures in the living space.
d) b and c
e) none of the above

____ 7. The absorber plate

a) must be kept clean.
b) should be highly reflective.
c) should be painted flat black.
d) should be heavily insulated.
e) a and c

____ 8. An advantage of active air systems is

a) lower cost
b) lack of building damage during freezing weather.
c) the requirement of less energy to blow air through ducts.
d) none of the above
e) a and c

____ 9. Air spaces

a) assist air flow into storage
b) are important for efficient collection.
c) help to insulate the heat storage.
d) provide the necessary space for a hot water system.

____ 10. Solar heating of domestic hot water

a) requires that the heat collected by the collectors be placed in liquid storage.
b) requires an entirely separate system if an active air system is installed for heating the living space.
c) requires a heat exchange system if an active
d) requires that the hot water tank be placed in the rock bed.

UNIT IV--ACTIVE LIQUID SOLAR ENERGY SYSTEMS

I. Select the best or most correct answer and write the letter corresponding to that answer in the space provided by each item.

____ 1. Types of liquid solar collectors are:

a. flat plate
b. concentrating.
c. trickly down.
d. none of the above
e. all of the above

____ 2. The proper size for a storage tank in an active liquid system

a. can be of any size the building can support.
b. 1.5 to 2 gallons per square feet of collector.
c. 10 to 15 gallons per square feet of collector.
d. .5 to 1.0 gallons per square feet of collector.

____ 3. An advantage of active liquid solar systems is

a. the pipes used in active liquid systems are easier to install and retrofit than air ducts.
b. leaks can cause freezing pipes.
c. pumps take more energy than fans.
d. pressure and temperature relief fans are needed.
e. none of the above.

____ 4. Collectors used for providing heated water for swimming pools

a. are more expensive than those used for heating domestic hot water.
b. are less expensive than those used for heating domestic hot water
c. are more complex than those used for heating domestic hot water.
d. none of the above.

____ 5. Temperature relief valves are needed in active liquid solar systems

a. to allow for the release of steam.
b. to assure that water gets to a high temperature.
c. as a safety measure to assure that water is not too hot.
d. in order for the system to function.
e. none of the above.

Page 2
Unit IV

II. Place an "x" in front of the statements below which are true.

____ 1. An auxiliary heating system is installed for the purpose of providing a back up system during long cloudy periods.

____ 2. If collectors used in an acitve liquid system are not oriented exactly South, efficiency is greatly impaired.

____ 3. A trickle down liquid solar collector is low cost compared to other types.

____ 4. Collectors are fairly sturdy and some rough handling in transpost and installation usually doesn't lower performance.

____ 5. If the size of the storage tank is too large in comparison to the collector size a desirable temperature of stored liquid might not be reached.

____ 6. A radiant floor slab is an example of a storage component in an active liquid system.

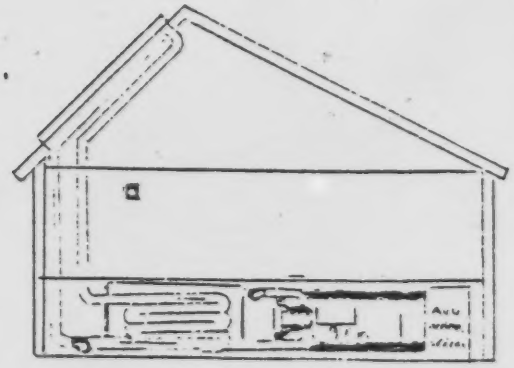
____ 7. A flat plate collector collects energy at a higher temperature range than the tracking concentrating collector.

____ 8. Freeze protection is not necessary when using an active liquid solar system.

____ 9. Check valves prevent water from circulating in an opposite direction when the collectors are cooler at night.

____10. Active liquid solar systems are less expensive than passive solar systems.

III. The following diagram is of an active solar (a) liquid (b) air heating system.



Label the three major components of the solar heating system.

a. _____

b. _____

c. _____

UNIT V

I. Decide which of the statements in the column on the right most correctly defines each term given in the column on the left. Write the letter representing this statement in the blank to the left of each solar-related term.

____ 1. Thermosyphoning Loop

____ 2. Bread Box Unit

____ 3. Retrofit System

____ 4. Trombe Wall

____ 5. Passive System

____ 6. Draindown System

____ 7. Thermal Mass

a. Pumps on fans are used to move the energy or heat.

b. A thermal storage wall made of masonry and painted black on the sun side, with an air space, glazing and air vents.

c. An inexpensive unit fitted to the south side of the house. It has very little thermal mass and operates only during the day.

e. A simple and low-cost solar domestic hot water system.

f. Large amounts of masonry or water used for heat storage.

g. A thermal storage wall in which water is stored in drums painted flat black on the sun side.

h. As a means of freeze protection, a switch is used to run water out of the collector and to replace the water with air.

i. A sunspace with south facing glazing and large amounts of masonry or water filled containers for storage.

j. A solar energy system is added to an existing house.

Page 2
Unit V

II. Place an "X" in front of the statements below which are true.

____ a. When adding a Trombe wall, if the existing wall is insulated, radiation can be used as a means of heat transfer.

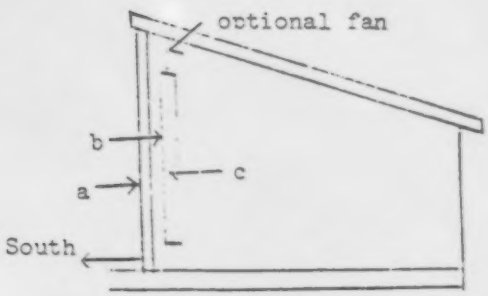
____ b. Solar systems to heat domestic water are cost-effective at the present time.

____ c. Since water temperatures from collectors are not hot enough, a tempering valve is used to add more hot water to keep the temperature of the water at approximately 140°.

____ d. If a greenhouse is added, steps must be taken to prevent overheating in the summer.

____ e. In the retrofit of an active system, a part of the system could be left out.

III. Below is a diagram of a Trombe wall. Label the parts indicated and indicate the direction of air flow through the vents (6 points).



THERMAL STORAGE WALL
(Trombe or Drumwall)

1. a. _____

   b. _____

   c. _____

2. Use arrows to indicate, in the diagram, the direction of air flow, and label each direction appropriately.

3. One important feature is missing from the building. What is it?

   _____

IV. Select the one best or most correct answer and write the letter corresponding to that answer in the space provided by each item.

____ 1. In deciding to retrofit a solar system to an existing house, one must examine the house in terms of

   a. the size of south-facing windows, the amount of thermal mass, and the amount of insulation.
   b. weathertightness.
   c. the orientation of the roof.
   d. the foundation.

____ 2. In retrofitting a Trombe wall

a. radiation cannot be used as a means of heat transfer.
b. the larger the amount of thermal mass, the better will be the performance.
c. larger vents will provide more heat at night.
d. none of the above.

____ 3. The simplest and most effective solar retrofit is

a. a greenhouse.
b. a thermal storage wall.
c. a domestic hot water system.
d. an air-lock entry.

____ 4. A drum wall requires

a. a heavy foundation.
b. reflector surfaces.
c. glazing.
d. insulating walls.
e. all of the above.

____ 5. In a thermosyphoning system,

a. the solar storage tank is below the collector but must be higher than the existing hot water heater.
b. the solar storage tank must be higher than the collector.
c. a flat-plate collector is not used.
d. b and c

____ 6. A retrofit solar system for a swimming pool is

a. a good application because high temperatures are not needed.
b. a good application because low-cost collectors can be used.
c. a good application because the existing circulating system can be used.
d. none of the above
e. all of the above

____ 7. An active retrofit system should be used on an existing house

a. if there is not enough south-facing wall.
b. only if there is room to add a storage system.
c. only if the axisting heating system includes a heat exchanger.
d. a and c

DIRECTIONS: Please read each question carefully. Place a check in the blank to the left of the response which you feel best answers the question.

1. What age are you?

___ Under 18
___ 18-30
___ 31-40
___ 41-55
___ Over 55

2. How many hours per week do you spend watching television?

___ Less than 5
___ 5-10
___ 11-20
___ More than 20

3. How many hours per week do you spend reading? (Newspapers, books, magazines, etc.)

___ Less than 1
___ 1-5
___ 6-10
___ More than 10

4. How much formal education have you had?

___ Some high school
___ High school graduate
___ Some college
___ Certificate program completion or associate degree
___ College graduate
___ More than B.S. degree

5. On a scale of 0 to 3, how would you rate your learning as a result of viewing the television series on solar energy?

___ 0 (I learned nothing)
___ 1 (I learned a small amount.)
___ 2 (I learned a moderate amount.)
___ 3 (I learned a great amount.)

6. Did you enjoy the television series on solar energy principles?

___ Yes
___ No

7. Would you rather learn about solar energy by reading a book, by television, or having an instructor explain solar energy?

___ Television
___ Book
___ Instructor

8. Would you recommend the television program on solar energy to others?

___ Yes
___ No

APPENDIX F

CODING OF VARIABLES FOR ANALYSIS OF DATA

In analyzing the data collected in the study, the variables were coded as follows:

Variable	Code or Score	Column (s)
SCHOOL NO		1
Dona Ana Branch	1	
Clovis Branch	2	
Code No.	001 . . .006	2-4
TREAT1		
No television	0	5
Television	1	
PREUNIT1	Numerical Score on Pretest 1	6-7
POCUNIT1	Numerical Score on Posttest 1	8-9
TREAT2		10
No television	0	
Television	1	
PREUNIT2	Numerical Score on Pretest 2	11-12
POSUNIT2	Numerical Score on Posttest 2	13-14
TREAT3		15
No television	0	
Television	1	
PREUNIT3	Numerical Score on Pretest 3	16-17
POSUNIT3	Numerical Score on Posttest 3	18-19
TREAT4		20
No television	0	
Television	1	

Variable	Code or Score	Column (s)
PREUNIT4	Numerical Score on Pretest 4	21-22
POSUNIT4	Numerical Score on Posttest 4	23-24
TREAT5		25
No television	0	
Television	1	
PREUNIT5	Numerical Score on Pretest 5	26-27
POSUNIT5	Numerical Score on Posttest 5	28-29
AGE		30
Under 18	1	
18-30	2	
31-40	3	
41-55	4	
Over 55	5	
TVWATCH (Hours per week watching television)		31
Less than 5	1	
5-10	2	
11-20	3	
More than 20	4	
HRSREAD (Hours per week reading)		32
Less than 1	1	
1-5	2	
6-10	3	
More than 10	4	

Variable	Code or Score	Column
Formed (Formal Education)		33
Some high school	1	
High school graduate	2	
Some college	3	
Certification program completion or associate degree	4	
College graduate	5	
More than BS degree	6	
Rating (Rating of learning from television series)		34
Learned nothing	0	
Learned a small amount	1	
Learned a moderate amount	2	
Learned a great amount	3	
Enjoy (Enjoyment of television series)		35
No	0	
Yes	1	
TVBKIN (Preferred Mode of Learning)		36
Television	1	
Book	2	
Instructor	3	
RecomTV (Recommendation of television series)		37*
No	0	
Yes	1	
Level 1		40
Low pretest score on unit 1	0	
High pretest score on unit 1	1	
Level 2		41
Low pretest score on Unit 2	0	
High pretest score on Unit 2	1	
Level 3		42
Low pretest score on Unit 3	0	
High pretest score on Unit 3	1	
Level 4		43
Low pretest score on Unit 4	0	
High pretest score on Unit 4	1	

Variable	Code or Score	Column
Level 5		44
Low pretest score on Unit 5	0	
High pretest score on Unit 5	1	

Missing values were coded 9 or 99 depending on the number of columns for the variable.

*Columns 38 and 39 were left blank.

APPENDIX G

MULTIPLE REGRESSION TABLES

OF SELECTED VARIABLES ON POSTTEST

TABLE 56

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT II
ON SELECTED VARIABLED
FOR DONA ANA PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit II	.08	.01	.01	.08	.08
Level of formal education	.18	.03	.03	.17	.76
Age	.21	.04	.01	-.03	.19
Treatment II (TV vs Regular Instruction)	.21	.04	.00	.01	.00

R^2 = .21 F(4,21) = .22 p .05

* = Significant at .05 level

TABLE 57

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT I
ON SELECTED VARIABLES
FOR DONA ANA PARTICIPANTS

Independent Variable	R	R^2	R^2 Change	Simple r	F
Pretest score on Unit I	.40	.16	.16	.40	2.06
Level of formal education	.46	.21	.05	-.22	.78
Age	.46	.21	.00	-.16	.02
Treatment I (TV vs. regular Instruction)	.56	.31	.10	.47	3.11

R^2 = .31; F(4,21) = 2.36 p .05

* = Significant at .05 level

TABLE 58

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT I
ON SELECTED VARIABLES
FOR CLOVIS PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit I	.50	.25	.25	.50	*9.78
Level of formal education	.50	.25	.00	.10	.63
Age	.57	.32	.07	.29	1.88
Treatment I (TV vs. regular instruction)	.57	.33	.00	.24	.20

R^2 = .33; F(4,30) = *3.62 p .05

* = Significant at .05 level

TABLE 59

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT III
ON SELECTED VARIABLES
FOR CLOVIS PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit III	.11	.02	.01	.11	.02
Level of formal education	.11	.01	.00	.01	.08
Age	.15	.02	.01	.08	3.16
Treatment III (TV vs. regular instruction)	.74	.55	.52	.69	*34.31

R^2 = .55; F(4,30) = *8.97 p .05

* = Significant at .05 level

TABLE 60

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT II
ON SELECTED VARIABLES
FOR CLOVIS PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit II	.02	.00	.00	.02	.16
Level of formal education	,44	.19	,19	-.44	*4.39
Age	.45	.20	,01	-.31	.01
Treatment II (TV vs. regular instruction)	.48	.23	.04	.26	1.35

R^2 = .23; F(4,30) = 2.27 p .05

* = Significant at .05 level

TABLE 61

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT
ON SELECTED VARIABLES
FOR DONA ANA PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit V	.67	.45	.45	.67	*21.06
Level of formal education	.67	.45	.00	.05	.17
Age	.72	.51	.06	.21	2.38
Treatment V (TV vs regular instruction)	.78	.61	.10	.41	*5.06

R^2 = .61; f(4,20); *7.88 p .05

* Significant at the .05 level.

TABLE 62

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT IV
ON SELECTED VARIABLES
FOR DONA ANA PARTICIPANTS

Independent Variables	Multiple R	R^2	R^2 Change	Simple	F
Pretest score on Unit IV	.73	.54	.54	.73	*12,08
Level of formal education	.77	.59	.05	-.14	2.04
Age	.77	.59	.00	-.45	.00
Treatment IV (TV vs regular instruction)	.78	.62	.03	-.45	1.07

R^2 = .62; F(4,14); * 5.59 p .05

*Significant at the .05 level.

TABLE 63

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT IV
ON SELECTED VARIABLES
FOR CLOVIS PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit IV	.08	.01	.01	.08	.23
Level of formal education	.16	.03	.02	.14	.66
Age	.18	.03	.01	.03	.05
Treatment IV (TV vs regular instruction)	.19	.03	.00	.03	.09

R^2 = .03; F(4,28) = .25 p .05

* = Significant at .05 level

TABLE 64

MULTIPLE REGRESSION FOR POSTTEST SCORES FOR UNIT V
ON SELECTED VARIABLES
FOR CLOVIS PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple r	F
Pretest score on Unit V	.23	.05	.05	.23	.35
Level of formal education	.32	.10	.05	-.19	*6.61
Age	.47	.22	.11	.20	2.72
Treatment V (TV vs. regular instruction)	.57	.32	.10	.41	*4.84

R^2 = .32; F(4, 32) = *3.76 p .05

* = Significant at .05 level

TABLE 65

MULTIPLE REGRESSION OF POSTTEST SCORES FOR UNIT III
ON SELECTED VARIABLES
FOR DONA ANA PARTICIPANTS

Independent Variable	Multiple R	R^2	R^2 Change	Simple	F
Pretest score on Unit III	.59	.35	.35	.59	3.59
Level of formal education	.59	.35	.00	.06	.05
Age	.59	.35	.00	-.42	.02
Treatment (TV vs Regular instruction)	.74	.55	.20	.59	* 6.70

R^2 = .55; F(4,15); *4.62 p .05

* Significant at the .05 level.

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